February 1960

Insulation

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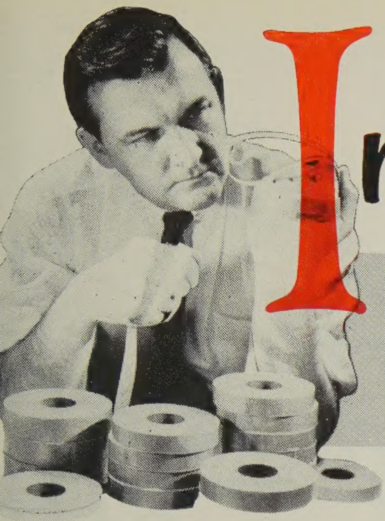

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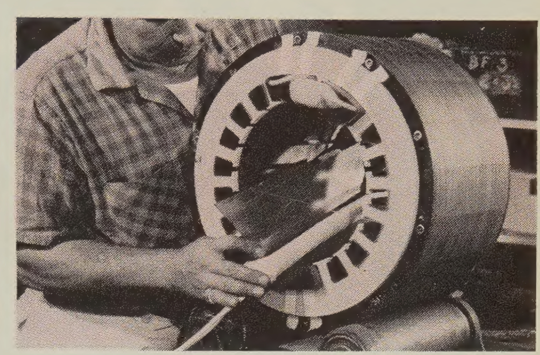
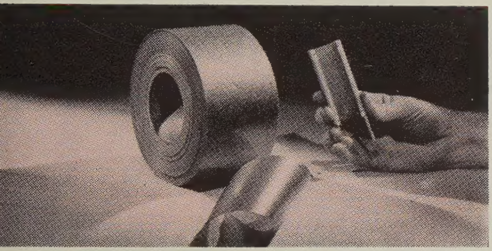


MOTOR SLOT AND COIL INSULATION



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Isomica mica paper insulation has come a long way since its introduction in 1951. Physical strength, electrical properties, handling characteristics have all been vastly improved until now, in many applications, it surpasses conventional pasted-up mica products.

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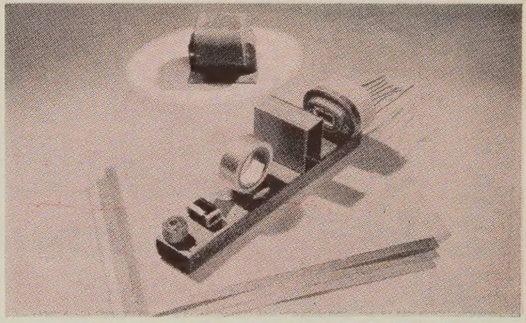
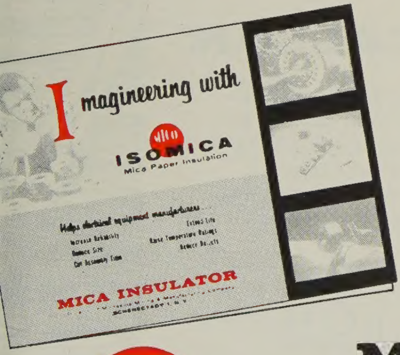


TRANSFORMER CORE TUBE AND LAYER INSULATION



Imagineering with ISOMICA can pay off for you too. A new bulletin "Imagineering With Isomica" tells you how. Use the handy coupon for your free copy.

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Unfailing stability at high operating temperatures is often the key requirement of MACALLEN Mica . . . in products ranging from toasters to diesel-electric locomotives. With MACALLEN Mica this vital insulating property can be applied in the widest range of shapes and sizes . . . with the greatest efficiency and economy. Solve *your* insulation problem with MACALLEN Mica . . . choice of the electrical industry since 1892. Send for free Catalog 25 today.

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Insulation

For the Electrical and Electronic Industries

e Publishing Corporation, 311 East Park Ave., Libertyville, Illinois, February 1960

The Effects of Radiation on Materials, Part 2
V. J. Linnenbom
Ceramic for Pen-Sized Radio
Statistical Methods of Control for
The Manufacture of High Voltage Stator Coils
R. M. Sexton
Novel Multiple Specimen Holder Reduces Variables
In Magnet Wire Thermal Investigations
Lee M. Johnson and Maxwell E. Sharp
Increasing Motor Capacity
With High Temperature Insulation
R. L. Nailen
Graph on Specific Gravity vs. Volume
Crush Grinding for Small Parts
Sealed Wiring Panels in Convair Jetliner
New Design Reduces Terminal Plate Cost

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NBP Member National Business Publications, Inc.

Advertising Sales Offices: See page 84.

From the Editor

Opinions and Rambling Thoughts

You Can Honor Outstanding Insulation Achievements

The electrical insulation field, which for so many years went unrecognized by those outside the industry, is well deserving of the stature and eminence it has achieved in recent years. The growth of the insulation field has been so significant that the time has now come to recognize the part played by those who have contributed to this growth.

The professional development and recognition department of the American Institute of Electrical Engineers has approved the establishment of the Whitehead Award. As the name indicates, this award recognizes the valuable contributions of Dr. J. B. Whitehead to the electrical insulation field. However, the award is not merely a tribute to the past—it provides the means for honoring insulation leaders of the present and encouraging the insulation leaders of the future. You as an individual can play an important part in honoring the men who have contributed and will contribute so much to the insulation field—you can do this by making a modest financial contribution to the Whitehead Award fund now.

The Whitehead Award has a threefold purpose: 1) to recognize outstanding achievements in the field of electrical insulation, whether these achievements be in the research, development, application, or teaching areas; 2) to stimulate interest in the field of electrical insulation, especially among young engineers and scientists; and 3) to honor the memory of Dr. J. B. Whitehead, an illustrious leader in the insulation field.

For the Whitehead Award to become a reality, it is necessary that $25,000 be raised or pledged. When this required endowment fund is raised, it is planned that the money will be turned over to AIEE for administration and handling. By investing the fund conservatively, it should yield a return which will cover the costs of a $500 cash award, medal, and certificate each year. The person who receives the award each year will be selected entirely on the basis of his achievements in the insulation field—he need not be a member of any particular professional society or group to qualify for the award.

Contributions to the Whitehead Award fund are needed in large amounts from industry and in lesser amounts from individuals. When deciding whether or not to contribute to such a worthy cause, it is too easy to figure that the next guy will contribute so that you do not have to—this message was not written for the next guy; it was written for you and it is being read by you. You can make out a $5 or $10 check right now just as easily as next week. Send your check to Prof. F. Hamburger Jr., Dept. of Electrical Engineering, Johns Hopkins University, Baltimore 18, Md. Note "Whitehead Award fund" on your check.

Dr. Whitehead is representative of many segments of the electrical insulation field. He served as chairman of the Conference on Electrical Insulation of the National Research Council from 1922 to 1939. He founded the School of Engineering at Johns Hopkins University and became its first dean in 1919, serving in this capacity until 1938 when he became director. In addition to other society affiliations, he was a fellow of the American Institute of Electrical Engineers, American Physical Society, and American Association for the Advancement of Science. He was president of AIEE in 1933-34. He received many honors and awards during his illustrious career. He was the author of a number of books and more than 100 technical insulation papers. Dr. Whitehead died November 16, 1954.

National Electrical Week

"Electricity sparks the '60s" is the official slogan for National Electrical Week, February 7 to 13. This is the week when all branches of America's electrical industry observe the birthday anniversary of Thomas A. Edison. Electricity has become so commonplace and necessary that it is easier to imagine the many novel new products electricity will bring us in the next decade than it is to imagine a world without electric lights, television, appliances, medical instruments, electrically powered production equipment, etc. Some of the predictions for the future include thermoelectric combination refrigerators and ovens, ultrasonic sinks, electric blankets that both heat and cool, electrostatic dusting wands, and television screens which will be located on walls of various rooms.

Electricity has brought us many things and will bring us many more. Everything you can do to help make your community more aware of the importance of electricity will help to make your industry and your job more secure and rewarding. National Electrical Week provides an ideal opportunity.

Washington Conference Contest Winners

As those who entered *Insulation's* identification contest at the insulation application conference in Washington, D.C., last December probably concluded, the contest required a great deal of time and skill—and unfortunately, everyone in the insulation field is so intelligent that we would have gone broke if we had not slipped in that little clause to the effect that in case of ties, a drawing would determine the winner. Because there were so many ties for first place, a drawing, properly presided over by one of our beautiful young girls, was held. Just so you will know that we are honest, first prize went to W. F Dripps, design engineer with General Electric Co. in Pittsfield, Mass. Second prize went to William R. Clay engineer, Textile Fibers Dept., E. I du Pont de Nemours & Co., Wilmington, Del.

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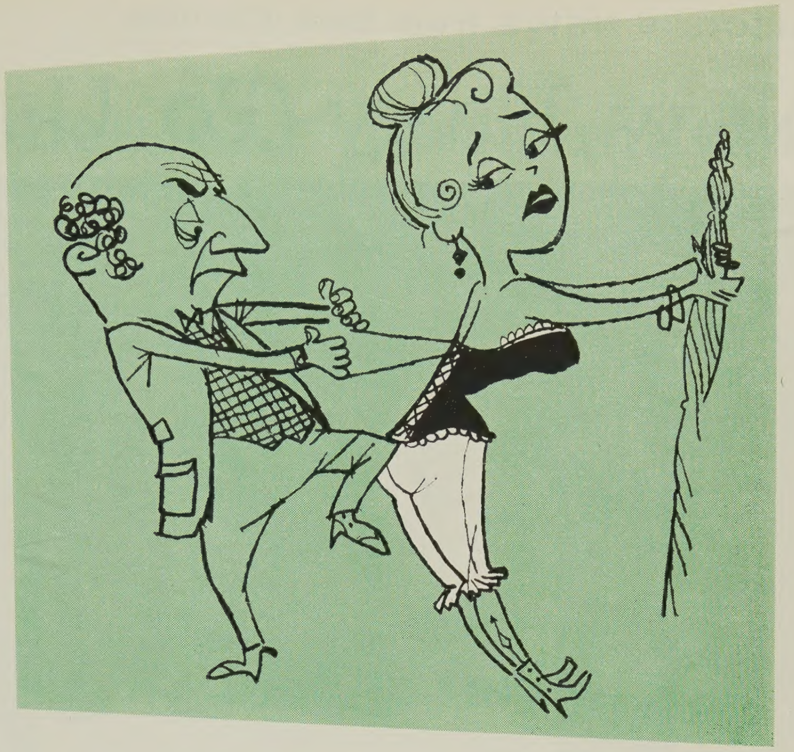
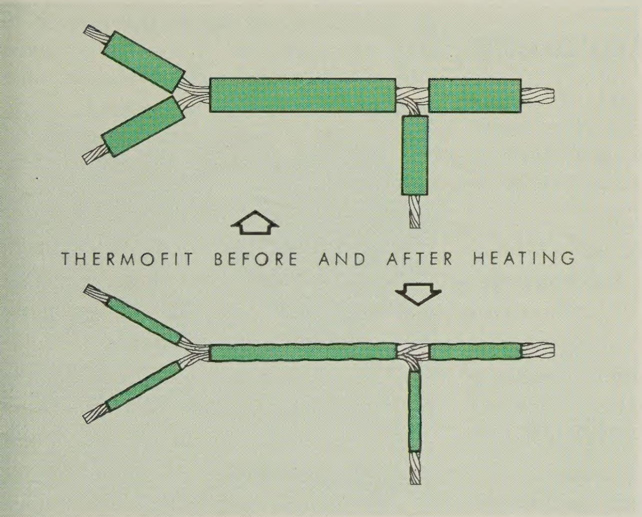


DO YOU HAVE HARNESS PROBLEMS?


THERMOFIT BEFORE AND AFTER HEATING

Thermofit is a new jacketing material for quick, efficient, durable "in plant" harnessing applications. It is supplied in an expanded diameter. Slip it over the wire bundle. Heat it briefly. It shrinks, giving the harness a tight, tough, high temperature, chemical resistant jacketing.

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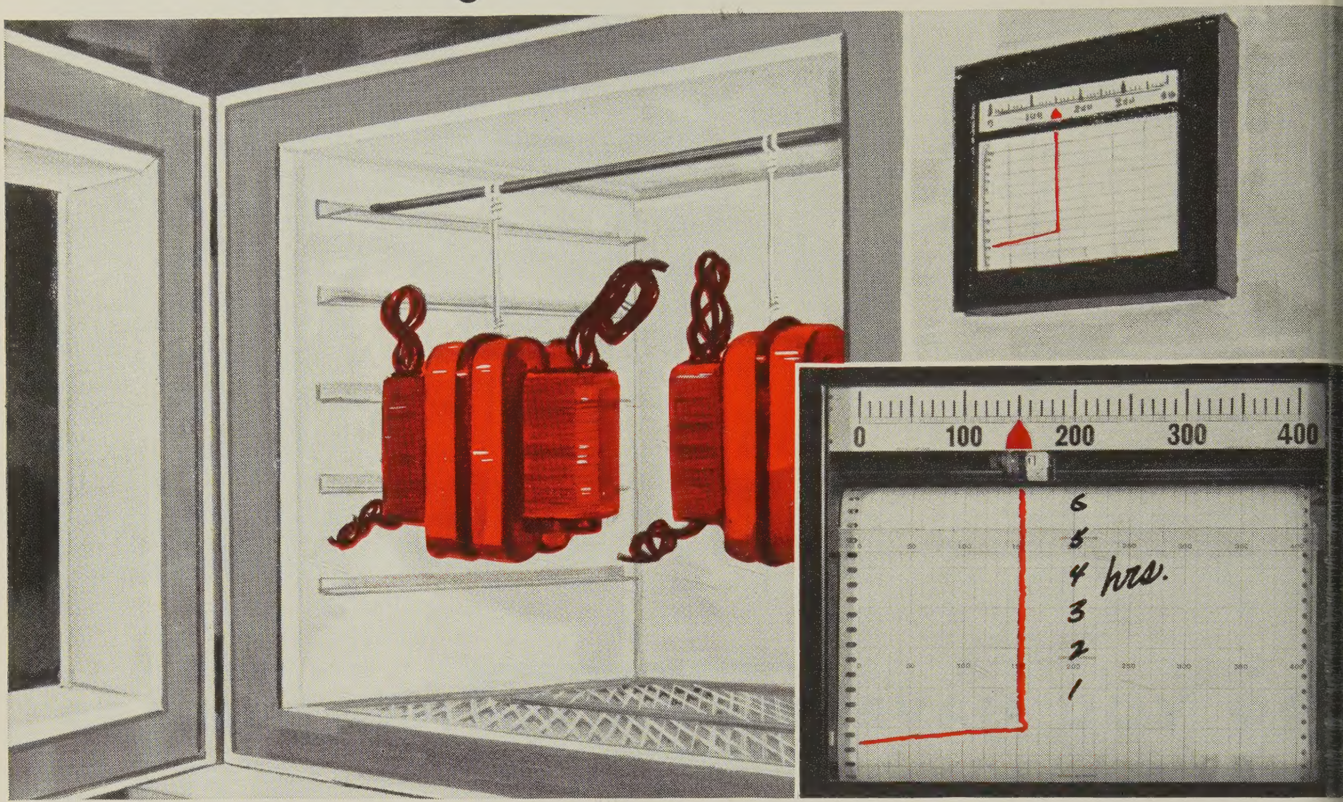
SILICONE NEWS from Dow Corning

New Easy-To-Use Varnish



New Dow Corning Varnish simplifies processing of Class H Transformers

An all-new Dow Corning Silicone Varnish opens a new era of easier, quicker, lower-cost processing of silicone insulation systems for transformers. An example of its cost-saving advantages: this new varnish cures in only six hours at 150 C . . . develops its bond strength at 50 C less than conventional silicone varnishes.

Now, because of this new Dow Corning Silicone Varnish, transformer builders equipped for Class A or B insulation systems are *automatically* equipped for Class H as well!

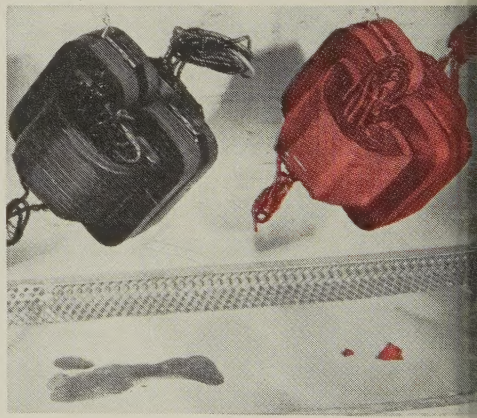
And there are other advantages too! Runoff is very slight. Compared to other varnishes, new Dow Corning 980 Varnish gives adequate buildup to the desired insulation thickness while reducing varnish waste . . . cleanup time. Big savings in processing time and equipment maintenance can be achieved.

Heat stability is even better than for silicone varnishes previously available. This new Dow Corning Varnish meets AIEE heat stability requirements for 220 C systems, resists moisture and is unaffected by many corrosive atmospheres.

When used with other silicone components in units designed for higher temperature rise, Dow Corning Silicones help make transformers smaller, lighter, safer, more reliable and virtually maintenance-free. Write today for complete data on this new cost-saving silicone varnish.

Other Cost-Saving Advantages:

In addition to curing in 6 hours at 150 Dow Corning 980 Varnish has excellen tank stability and will not soften, swell



deteriorate most insulating materials, in cluding silicone rubber. The varnish afford good penetration and will not drip off coi or handling equipment to create a maint nance problem. Lower curing temperature less runoff plus other economies substan tially reduce insulating costs.

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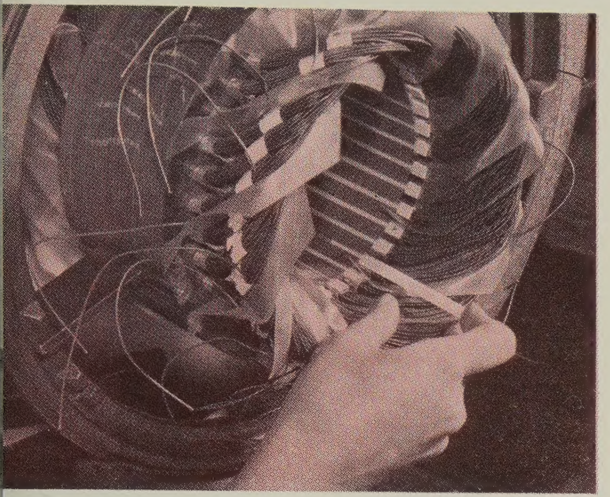
Your nearest Dow Corning office is the number one source for information and technical service on silicones.

first in silicones

Dow Cornin

.other silicones aid performance



icone-Glass Laminates Stay Strong

sticks made of silicone-glass laminates assure this -Chalmers 2-hp, 3-phase, 1750 rpm motor maximum bility, long service life in high ambient temperature ications. A typical application for this motor is on door opening devices where the ambient temper- e is 250 F.

one-glass laminates retain their mechanical strength, arc resistance, low loss factor and low moisture rption even after prolonged aging at 250 C . . . ide ideal structural-insulating properties.

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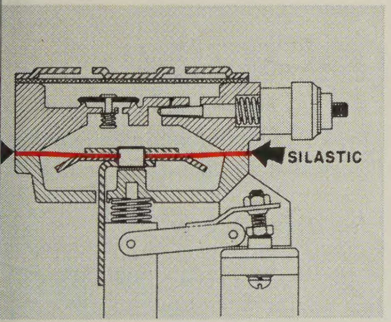
astic Assures Timer Accuracy



Even a minute change in the elasticity of the rubber diaphragm in this Square D pneumatic time-delay relay would adversely affect accuracy. That's why heat-and-cold-resistant Silastic®, the Corning Silicone Rubber, was selected. This sensi- diaphragm enables the timer to give accurate delays ing in duration from .05 seconds to 3 minutes . . . rdless of changing climatic conditions. Parts molded Silastic are exceptionally resistant to weathering, ation, ozone and temperatures from −70 to 250 C. y are available in almost any size, shape or color leading rubber fabricators.

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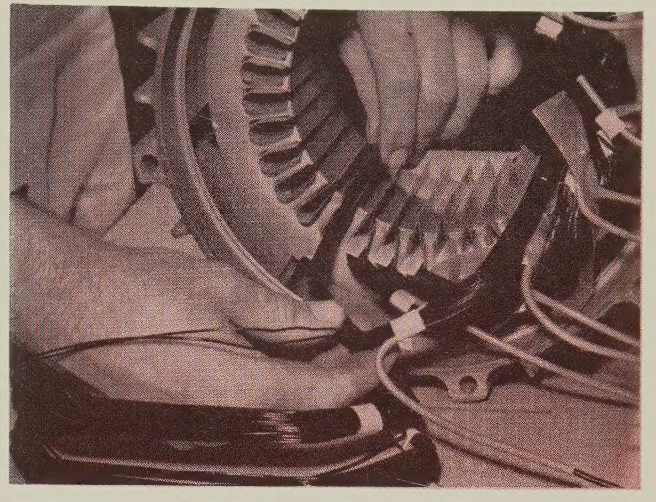

Sylkyd Enameled Magnet Wire Cuts Bulk

Easy-to-install Sylkyd® Enameled Magnet Wire eliminates needless bulk in high temperature insulation systems. Sylkyd coated wires are comparable in diameter to Class A insulated wires . . . allow a higher copper to iron ratio than fibre covered, high temperature wires . . . permit designs that supply maximum power per pound. They are performance-proved in 180 C insulation systems . . . will resist most chemicals, moisture, corona, dirt and many other environmental hazards. Sylkyd has long shelf life — won't craze, soften or become brittle in storage.

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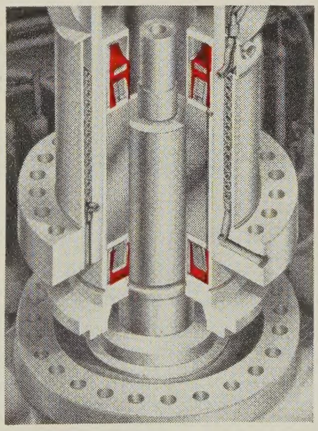
Silicone Resin "Locks In" Performance



Designed for maximum reliability, new Westinghouse removable stator canned motor-pumps like this one are used for better boiler circulation in controlled circulation conventional systems. Similar pumps are used to circulate radioactive liquid coolants at temperatures up to 650 F in hermetically sealed primary coolant systems of nuclear reactors.

End turns of stator coils are potted in Dow Corning solventless silicone resin to insure a solid, void-free fill of coil interstices. These solventless resins are radiation resistant, withstand vibration, oxidation, corona and moisture despite continuous service at high temperatures.

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ASESA Changes Re-evaluation Testing Procedure

The Armed Services Electro-Standards Agency director has announced a change in procedure for re-evaluation testing where manufacturers select the government laboratory option. As in the case where other options are selected, ASESA will specify a time limit for completion of re-evaluation testing and for test results to be made available to ASESA. Failure to pass re-evaluation tests or failure to be successfully re-evaluated within the time limit will result in removal from the applicable Qualified Products List (QPL) of products concerned. This procedure has been in effect for the in-plant and commercial laboratory options—putting it into effect for the government laboratory option prevents any unfair advantage.

High Temperature Research Contract

A $270,000 contract for research and development work on materials capable of withstanding temperatures exceeding 5500°F has been awarded to Sylvania Research Laboratories, a division of Sylvania Electric Products Inc. The work is being performed for Aerojet General Corp.

Electrical Outlook for 1960

Comes the new year and various associations, companies, and government agencies release estimates of what the new year holds. Here are some of the predictions:

According to the Business and Defense Services Administration, U.S. Department of Commerce, in 1959 electrical equipment sales increased about 8 percent over 1958 and 1960 is expected to show an increase of 5 percent over 1959. The industry includes about 2500 manufacturers of transmission and distribution equipment, motors and control apparatus, lighting equipment, and electrical construction materials. Total employment is approximately 550,000. Value of shipments in 1959 was more than $7.5-billion. For the various segments of the industry, the following *estimated* figures show, respectively, percentage increase of 1959 over 1958, percentage increase of 1960 over 1959, 1959 sales, and 1960 sales; Electrical power and distribution equipment—11%, 3%, $900-million, and $965-million. Integral horsepower motors—17%, 10%, $485-million, and $534-million. Wiring devices, lighting equipment, and secondary electrical distribution apparatus—11.5% for 1959 over 1958 and 3.5% for 1960 over 1959.

The National Electrical Manufacturers Association estimates that factory shipments of products within the electrical manufacturing industry reached a value of $21. billion in 1959, an increase of 11% over 1958, and th an all-time record of more than $23-billion will be set 1960, an increase of 7% over 1959. In the following li ing for various segments of the industry, the first thr figures are in millions of dollars and cover total indust shipments for 1958, 1959 (preliminary), and 1960 (for cast), respectively, while the last two percentage figur give the increase of 1959 over 1958 and 1960 over 195 respectively: Consumer products — $5,406.1, $6,029. $6,301.1, 11.5% and 5%. Lighting equipment—$1,313 $1,442.1, $1,538.8, 10% and 7%. Industrial electron and communications equipment — $5,266.0, $5,843. $6,332.8, 11% and 8%. Industrial equipment — $3,006 $3,462.8, $3,750.8, 15% and 8%. Building equipment $688.0, $748.5, $797.2, 9% and 7%. Insulating materia —$316.9, $403.7, $441.4, 27% and 9%. Insulated wi and cable—$1,307.5, $1,503.6, $1,654.0, 15% and 10 Generation, transmission, and distribution equipmen $2,047.0, $2,079.4, $2,242.3, 1.6% and 8%. Total ele trical manufacturing industry — $19,352.0, $21,51 $23,058.4, 11% and 7%.

In the preceding listing, it should be noted that NEMA figures for electrical insulating materials co only steatite electrical products, laminates, manufactur mica, varnished fabric and paper, varnished tubing, v canized fibre, electrical glass insulation, and combi flexible electrical insulation. Materials apparently not co ered by the figures would include various varnish resins, compounds, untreated paper, tapes, rubbers, mol ing materials, many ceramics, natural mica, many plasti cords, plastic films, wire insulation, etc.

In general, nearly all 1960 forecasts by individual ele trical manufacturers look for an increase of between 5 a 10% over 1959 . . . and the higher percentage may pr dominate now that the steel strike has been settled.

Plastics and Chemicals Up

Individual spokesmen in the plastics industry are pr dicting that the plastics field will continue to grow rapid C. M. Christie, president, Dayton Rubber Co., states th the plastics field, still in its infancy, is destined to beco an industrial giant and that plastics could well beco second only to steel as a basic material. Other leaders estimating that the industry will double in size during next decade.

In the chemical industry, the Manufacturing Chemis Assn. reports that a sales increase during 1959 of at lea $1.6-billion over the previous record year of 1957 w posted for an estimated 1959 total of $25-billion. Co tinued gains are forecast for 1960 with some authoriti predicting that sales in 1960 may total as much as $2 billion.

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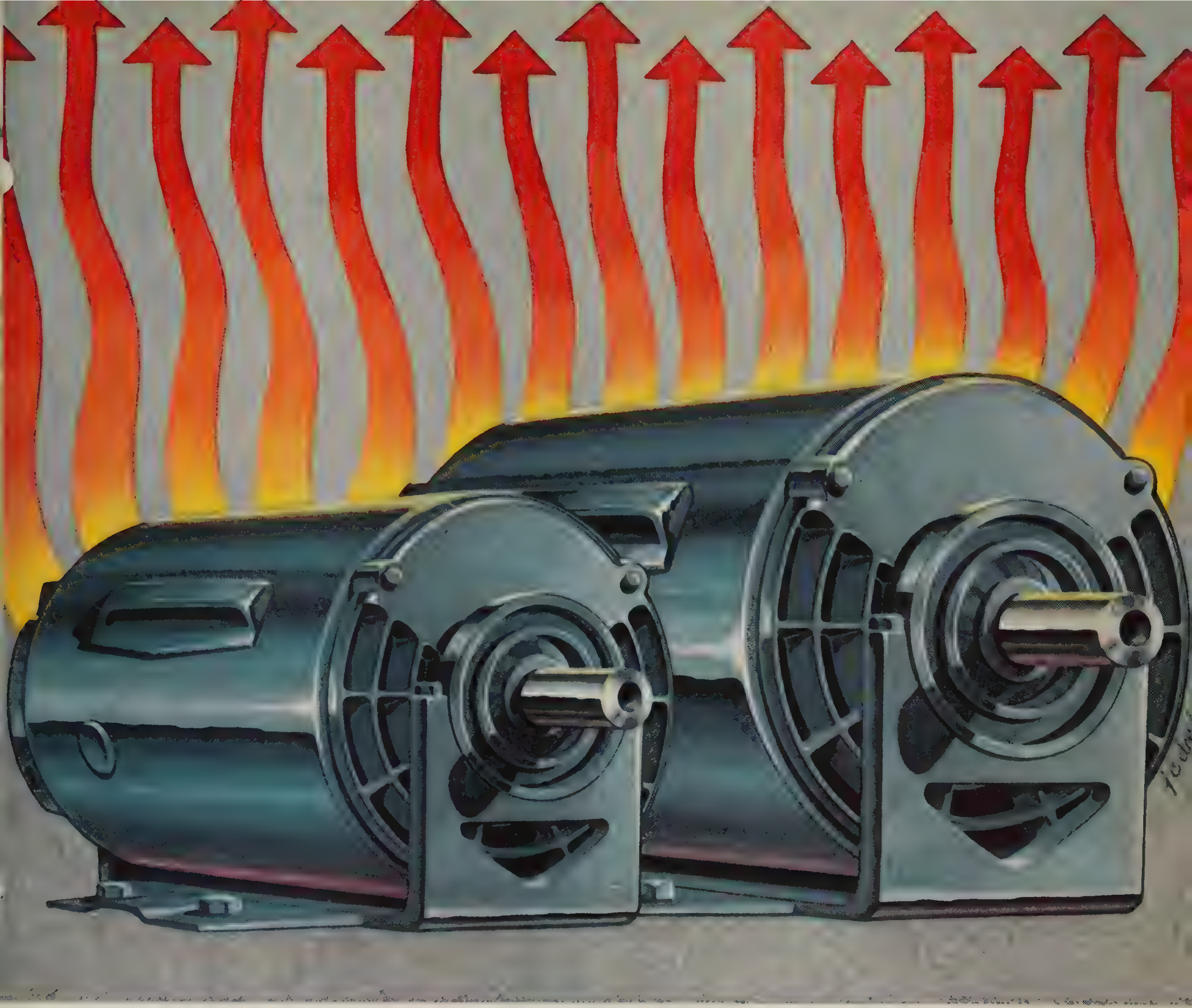


WHEN WINDINGS MUST RUN HOT—GET MORE HP PER POUND WITH 155°C ANATHERM MAGNET WIRE

ANATHERM—a polyester film-coated wire enables you to build a smaller motor without reducing horsepower output—enables your customers to operate motors at higher temperatures without loss of horsepower. In fact, wherever magnetic windings must run hot, Anatherm offers similar advantages.

But this is only part of the reason why Anaconda Anatherm has found such wide acceptance. Its greater thermal stability—plus excellent abrasion resistance, chemical stability and dielectric strength—help make Anatherm ideal for a wide variety of applications.

Anatherm—the first film-coated magnet wire to qualify for the AIEE Class F (155°C) rating has been field-tested and proved. Our broad application experience with Anatherm allows us to offer this wire in Sizes 8 to 46 in standard film thicknesses, and in a full range of round, square and rectangular sizes.

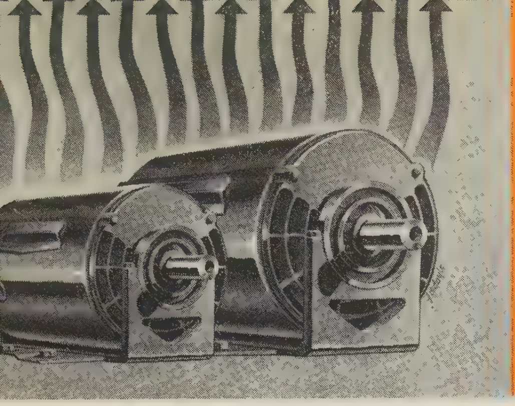
For more information, see the Man from Anaconda. Look up "Anaconda" in your phone book—in most principal cities—or write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y. 59250

ASK THE MAN FROM

ANACONDA®

ABOUT ANATHERM MAGNET WIRE

For you, Anatherm can mean smaller electrical equipment . . . higher operating temperatures. See details on reverse side.



MAGNET WIRE DATA SHEET

from

Anaconda Wire & Cable Co.

MPORTANT FACTS FOR YOUR WORK...

...about Anatherm 155°C (AIEE Class F) Magnet Wire

Vhen proper advantage is taken of Anaconda Anatherm's higher 55° C characteristics, electrical equipment can be improved in hese ways:

AISES LIMITING OPERATING TEMPERATURES. Anatherm raises miting operating temperatures to 155°C. This high heat restance means extra protection . . . longer equipment life . . . ider range of applications.

EDUCES FRAME SIZE. Anatherm gives more horsepower from he same space or the same horsepower from a smaller motor. osts are cut for you, and your customers benefit from smaller ver-all components.

NCREASES HORSEPOWER RATINGS. Anatherm is the best of he polyesters. Its high heat resistance means higher permissible perating temperatures, greater horsepower rating.

PGRADING. Anatherm helps upgrade standard equipment. ives added heat insurance through thermal stability. Particularly uited for overloads.

COMPATIBILITY. With polyesters, importance must be placed upon a completely compatible system. Varnish manufacturers have recently developed polyester varnishes which allow a compatible polyester magnet wire system. A number of varnishes other than polyester are compatible with Anatherm, but consultation with varnish suppliers before use is recommended.

TECHNICAL PROPERTIES

MECHANICAL PROPERTIES

natherm has unusually high abrasion-resistance. This characterstic allows it to be wound on both conventional and automatic winding equipment. Anatherm offers excellent flexibility and adherence properties. It meets NEMA snap test requirements and exhibits excellent adherence to the conductor.

ELECTRICAL PROPERTIES

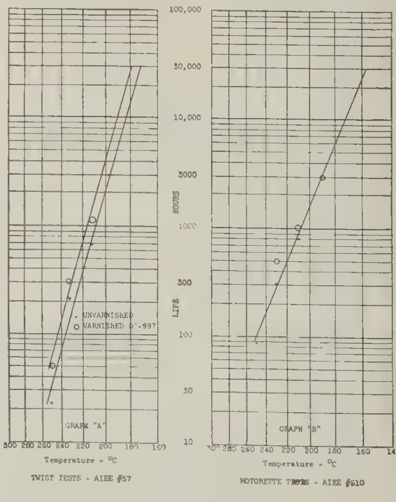
Anatherm maintains its dielectric strength under prolonged heating at high temperatures. It consistently exceeds dielectric strength requirements for NEMA dielectric twist test.

CHEMICAL PROPERTIES

Anatherm will resist toluol, VM & P Naphtha, Ethyl Alcohol and 5% Sulphuric Acid. Anatherm is a polyester and exhibits the best characteristics of this class of chemical compound. However, all polyesters must be used with certain precautions where moisture and/or enclosed systems are concerned. Similar precautions must be taken where chlorine-base supporting insulations, such as neoprene and polyvinyl chloride, are present. Polyesters should not be used in applications subject to exposure to concentrated alkalies.

THERMAL PROPERTIES

Anatherm is offered as a 155°C (AIEE Class F) magnet wire based on AIEE #57 and #510 test methods. These tests, performed by Anaconda engineers, show Anatherm as being capable of a 30,000-hour life at 157°C in an unvarnished state and the same life at 175°C when treated with a silicone or polyester type varnish. Thus Anatherm, when suitably varnished, has reserve stability even above the 155°C rating at which it is being offered. The thermoplastic flow temperature for Anatherm, based on MIL-W-583A, is very high (250°C). Anatherm also shows outstanding retention of flexibility after aging. Wire can be heated 168 hours at 175°C and then wound on three times its own diameter without cracking. Its heat-shock characteristics are exceptionally good for a polyester wire: Anatherm will withstand a 1x mandrel wrap at 155°C for one hour.



ANATHERM MAGNET WIRE

Valuable Anatherm Magnet Wire Handbook—

yours for the asking!

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TEAR OUT FOR YOUR FILE

Insulation Forum

This regular monthly feature is
ilt around a timely question con-
rning the electrical insulation field.
our suggestions for future questions
d participation are invited. This
onth's question is:

*In your opinion, what sort of busi-
ss conditions may we look forward
in the electrical/electronic insula-
on field, as a whole and/or in any
rticular segment or segments, dur-
g 1960 and why?*

. K. Davis

*ice President, Penn Fibre & Spe-
alty Co. Inc., Philadelphia.*

"My prediction for business in the
ectrical and electronic insulation
eld for 1960 is good—not excellent
very good but a rounded-out year
at will be looked back on as good
om a standpoint of volume and prof-
s. Our field, actually, is but a gen-
al reflection of over-all business con-
tions which will be neither record
eaking nor heart breaking.

"1960 will be a year of shaping
ents. While this is being written,
e steel workers are back on the job
nder the Taft-Hartley Act. However,
feel that they won't hit the bricks
gain. The feminine influence will
rce a settlement.

"However, this will present a prob-
m. As steel management gains cer-
in management rights it will tend
stiffen management. Other big in-
istries will want to get certain con-
ssions from the unions and we will
ive a year of labor strife as many
ntracts are coming up for renewal.
he railroad situation is an impor-
nt one.

"The settlement of the steel strike
ill not be the great boon to business
predicted. It will not take as long
believed to fill the pipe line of steel
pplies. This will cause a letting
own on steel production in the sec-
nd half.

"However, one field that will enjoy a good year will be automobiles and appliances (lots of business for electrical insulation). Autos will enjoy good business, but 1960 will not be a top year. Too many people getting on their financial feet after the steel strike will make the old car last a while longer.

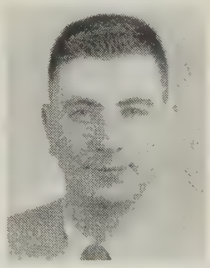
"Housing will be down because of the tight money policy. Plant building will go ahead at a greater pace than 1958 along with inventory accumulation, but not as well as anticipated because of tight money.

"1960 will see some progress toward a peaceful settlement of the sore spots on the foregoing issues. A few compromises will be put into effect that will lessen tensions. Defense spending will not be affected over-all but with speedy shifts that will dislocate some industries and build up others. This will not hurt the electrical and electronic insulation field. In fact, it will benefit.

"More people will be employed in the electrical and electronic insulation industry because of the great demand from the missile program and automation.

"Price tendencies will be up the first half . . . with resistance that will tend to hold them steady until fall when the warning signs of the next cycle recession will be very strong.

"Imports in our field will gain but not to a degree which will make too much difference over-all with the exception of perhaps holding down prices."



R. A. Weckstein

Manager, Purchasing, G-V Controls Inc., Livingston, N.J.

"The fields of electrical and electronic insulation represent a particularly dynamic aspect of the total electronic industry. Higher dielectric requirements, more rugged materials—literally shooting for the moon—have caused an apparent acceleration in technological research. The fruit of this research in 1959 put forth many new types and materials. Thus, it is reasonable to assume that there will be more applications for insulating materials in 1960. It is, of course, difficult to place this new technology in the form of an equation and come out with a prediction for 1960.

"If we ignore for a moment the new materials and new applications and examine some of the standard economic indicators, we can make a conjecture for 1960. One of the best indicators of industrial production is the Federal Reserve Index of Electrical Machinery. This index in the past few months has shown a rather steep upward trend. Since insulation is correlated with electrical machinery, it is reasonable to assume that insulation will show an upward trend. However, the NEMA Electrical Insulation Index may be contrasted with the Federal Reserve Index. This NEMA index has shown a moderate downward trend since April of this year. It should be stated that this index covers selected insulation products, but it is still a reasonably reliable industry index.

"If we were to accept either of the preceding indices as accurate, and were to take a middle course, it would have to be predicted that the insulation business would be just about the same in 1960 as it was in 1959.

"There is another dimension of this problem which should be considered. This is the trend in the electronic industry toward miniaturization wherever possible. This trend will of course reduce the material content of all products which are so miniatur-

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ized. Micro-miniaturization and solid state devices further reduce material content.

"In the light of the foregoing comments, I think that I would have to predict that business in the insulation industry will be very slightly better than in 1959. I think that the new materials will cause a more substantial increase in over-all industry production in 1961 and 1962.

"I would also like to comment on a particular area of interest to our firm. This is 'natural mica.' As is quite evident from the nature of the material, the world supplies of 'natural mica' are being slowly depleted. It will be many, many years before there is anything to worry about other than keeping the lines of trade open in the foreign areas where the mica is now found. I do hope though, that in 1960 or soon after, a substitute for natural mica can be found which is equal in all regards."

J. F. Bufalino

President, The Huse-Liberty Mica Co., Peabody, Mass.

"The year 1960 and the following decade seem to convey a magical degree of optimism when mentioned in connection with the electronic field. Many factors contribute to this, some of which are the predicted great growth in population and our continued efforts to achieve success in outer space.

"All outer space missiles contain electronic equipment which has been and will continue to be extremely helpful in advancing the fields of science and medicine, which in turn will give us a longer life span and contribute to improved standards of living. Mica, in one form or another, is used in practically every piece of electronic equipment.

"The natural mica industry, of which we are a part, has been faced with unusual and difficult problems in the past ten years. Foreign competition unquestionably heads the list in ours and other segments of the mica industry.

"The growth rate chart for the electronic and its closely allied electrical industry indicates a steady upward trend and for our industry it appears at 1960 will be at least 15% above 959 which was (before the steel rike) 20% greater than 1958. This ediction is based on sufficient steel id copper being available for elec onic requirements."

F. Herslow

ice President, The Sillcocks-Miller ., Maplewood, N.J.

"More than ever before the rewards free enterprise will be paid out to e progressive firms who, while not cessarily big, think big. Each year, pecially since the war, it becomes creasingly evident that firms can t rest on past laurels, but must con ually test and research not only to ow in size, but in many cases just to y solvent.

"As specialists in the fabrication plastics, last year made it signifi ntly evident to us and others how astics must work hand-in-hand with ctronics. All of us must realize the gnificance of the first Sputnik and w crucial it is to be foremost in ctronics. However, how many of us ve grasped the scope of the tremen us rewards available for new plastic oducts developed perhaps by those o do not think 'conventionally,' but o expect and demand that plastics jobs hitherto thought impossible.

"Reports from our sales offices in e various sections of the country in cate a rising sales trend everywhere r 1960. Key executives in the insu ion field to whom we've spoken in e past few weeks bear out these re rts. Staple products for our cus mers are currently being ordered quantities in excess of their normal e pattern and quotation requests for 60 purchases indicate a favorable ntinuance of this pattern."

W. C. Jenner

anager, Electrical Insulating Div., oughton Laboratories Inc., Olean, Y.

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tronic insulation field in 1960 is, of course, tied to the over-all picture of business in the electrical/electronic field itself. This, fortunately, looks good. Increased requirements are forecast within the power, appliance, instrumentation, and electronic segments.

"Within the insulation field, we are primarily interested in the application of epoxy-based insulating compounds. We feel that the use of such systems will grow at a greater rate than the electrical/electronic field growth which has been projected by some people at 6% electrical and 30% electronic.

"There are several factors which influence the growth rate of our particular industry. These include:

1. Advanced epoxy-based systems and their application technology which, in the past several years, have proved themselves. Many satisfactory installations have been described, thus encouraging further use and replacement of older systems.
2. The advancement of knowledge in the use of epoxy-based systems has been outstanding. This applies to the user as well as to the producer. Better and more application can, therefore, be made, even without pretesting in a great many cases. Continued education is certain through our publications, technical societies, and the accurate reporting of data by producers. This can only result in increased interest and ultimate use.
3. New epoxy-based systems will certainly become available in 1960 to give improvements in those areas where needed. In particular, we can expect easier handling embedding materials, improved flame resistance, higher operating temperatures, greater shock resistance, greater thermal conductance, and truly flexible materials. Applications are actually waiting for these products.
4. Government facilities have recognized the desirability of certain epoxy-based systems and have included them in specifications or on QPL lists. More such listings may be expected during the coming year.

"In view of these facts, 1960 will be another good year for epoxy compounds in the electrical/electronic insulation field."

R. S. Fisher

Vice President, Sales, National Vulcanized Fibre Co., Wilmington, Del.

"It is our feeling that there is a very good possibility of some unsteadiness in business in 1960, although I believe that 12 months from now the electrical/electronic industry and its suppliers may be able to look back with some satisfaction and see that 1960 equaled sales for 1959, but that we may be facing an entirely different set of circumstances going into 1961.

"Strikes and threats of strikes can alter the best laid plans, and indeed have already affected the confidence a forecaster can have in the most carefully worked out predictions for the short time. It is our feeling that we may have a couple of rocky months in the first half of the year due to various strike situations confronting the economy. However, we will snap out of this and on the whole have a fairly respectable year.

"It would be presumptuous to apply our company's outlook beyond our own product lines, but since these plastic materials are used in most electrical and electronic gear, our general conclusions may be of value. They are based, in good part, on projections which we have from our individual customers through our salesmen.

"Profitwise, we predict the going will be tougher in 1960 than it was in 1959. There is every indication that we will have increased costs from our own suppliers, and surely there will be increases in labor rates, which we do not feel can be entirely offset by increased productivity. It is also our feeling that little can be done in the passing along of these costs in view of the highly competitive situation which now exists in the electrical and electronic industries."

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Write for Data Sheet 2-0 and samples. Taylor Fibre Co., Norristown 51, Pa.

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The Effects of Radiation on Materials

Part 2—Radiation Damage Mechanisms: Metals, Inorganics, & Organics

By V. J. Linnenbom, Head, Radiation Effects Branch, Radiation Div., U. S. Naval Research Laboratory, Washington, D. C.

We have discussed thus far the various kinds of ionizing radiation and their interaction with the constituent electrons and nuclei of matter. As a result of these interactions, energy is transferred to the material being irradiated. Most of this energy is transferred through the processes of ionization and excitation, with only a relatively small fraction being transferred via the mechanism of atom displacement. This is true for all materials, regardless of type.

However, the changes in properties which are observed to occur in irradiated materials are very much dependent on the nature of the material. In some types of materials (e.g., organics), the effects produced have been found to be proportional to the total energy absorbed; it therefore follows that ionization and excitation processes are the important mechanisms leading to radiation damage in these materials, and that atomic displacement is relatively unimportant. On the other hand, in materials where ionization and excitation produce no significant changes (e.g., in metals), the major effects of radiation must be ascribed to displaced atoms or other radiation-induced structural defects. For these materials, the concept of absorbed dose as a measure of radiation effects breaks down, and other criteria, such as the number of displacements, must be used. It will therefore be of interest to consider how the nature of the material can influence the effects produced.

In general, the behavior of any material toward radiation (and indeed toward all environmental factors) depends on the arrangement of its atoms and molecules (crystalline structure), and how they are held together (bond type). Based on this picture of atomic structure, one can classify materials as to whether they are metallic, inorganic, or organic.

This time-honored classification, it must be admitted, is not entirely adequate for our purpose. We still lack sufficient knowledge to correlate the macroscopic properties of materials with atomic structure. We are even less able to predict changes in properties from what we know of the interactions of radiation on an atomic scale It might well be argued that a more utilitarian approach could be made, based on the use to which a material is put (e.g., lubricants, insulating materials, adhesives, heat transfer media, etc.). Yet while this classification may be more convenient from the user's standpoint, it evades the basic problem we are considering, namely, how radiation affects materials, and why some materials are affected more than others. If it is remembered that no one approach is as yet completely successful in answering these questions, it will be instructive to begin such an attempt by describing the mechanisms by which radiation effects are produced in the three general categories: metallic, inorganic, and organic. This will be followed by a discussion of more specific effects in insulating materials (Part 3, next issue). For the sake of brevity, the discussion will be limited to solids.

Metals

Metals in general have by far the highest degree of radiation stability. Many years ago, Lorentz described a metal as a crystalline arrangement of positively charged metallic ions with free electrons moving about in the interstices. This picture of a rigid lattice permeated throughout by a free "electron gas" provides a simple explanation of electrical and thermal conductivity, high heat capacity, and other properties of metals. It is also very useful in helping to explain the behavior of a metal exposed to radiation.

When a metal is irradiated, ionization and excitation processes occur as usual through interaction of the radiation with electrons. However, the energy absorbed in this manner is rather quickly dissipated as heat, so that the only measurable end effect produced by these processes is a rise in temperature of the metal. When atomic displacements occur, usually as a result of collisions with neutrons, the results are more serious. Vacancies in the lattice structure are created. The primary displaced atoms are slowed down by secondary collisions, producing further displacements. Eventually, all the displaced atoms come to rest at other sites in the lattice where they do not belong, becoming known as interstitial atoms. The secondary processes as usual far outnumber the primary processes; it has been estimated that a single 2 Mev neutron in a metal such as copper will produce about 1,000 displaced atoms. If produced in sufficient quantity, the vacancies and interstitials, which are classed as structural defects, lead to measurable changes in the properties of a metal. However, since only a small fraction of the total energy transferred to the metal from the radiation is by way of the atom displacement process, it becomes apparent that measurable effects begin to appear only at very high levels of radiation (e.g., 10^{20} neutrons/cm^2).

This simple displacement process by no means completes the picture. Other processes are also occurring, and of these the so-called temperature-spike and displacement-spike effects are worth mentioning. Both involve transfer of energy (via recoil atoms) to a highly localized region within the metal, the end result of which can be described as a heating up beyond the melting point of this localized region, which is then very quickly cooled by thermal conduction. Several theoretical treatments have indicated that this corresponds to "melting" of a submicroscopic region of only a few thousand atoms, which is subsequently quenched in a fraction of a microsecond. This type of process leads to further lattice defects.

It should be evident by this time that the above processes lead to property changes which do not depend simply on the total energy absorbed by the material. Since a large part of the energy absorbed by metals (through ionization and excitation processes) appears as heat, annealing or the disappearance of defects is occurring simultaneously with the production of defects. For example, a rise in temperature affects the mobilities of the interstitials and vacancies; the greater the mobility, the greater the probability of recombination of the two, and the greater the rate of disappearance of the defects. The end result is that a unit of absorbed dose like the rad has no significance for radiation effects in metals, since much of the energy absorbed through one mechanism (ionization plus excitation) is effective in annealing out the damage resulting from a different mechanism (atom displacements). Thus far, the extent of the interaction between radiation and a metal has been measured in terms of the number of events which have taken place. This is as yet not too satisfactory a method.

In general, there is little indication thus far that properties of metals such as thermal conductivity, electrical resistivity, or density, undergo any appreciable changes upon irradiation, even with fast neutrons. This is easy to understand from the simple model of a metal outlined above*. On the other hand, those properties of metals which are structure sensitive (yield strength, hardness, ductility, etc.) usually experience a considerable change upon prolonged exposure to fast neutrons, a phenomenon which necessitates a judicious selection of metals for use in reactor construction. Except for the heating effect, the interaction of gamma radiation with metals can usually be ignored.

Inorganic Materials

This category is necessarily a rather heterogeneous mixture, since it may contain compounds with bond types ranging from purely ionic through mixed ionic-covalent to purely covalent bonds. In considering this category, we must resort to the band theory of solids for help in explaining certain radiation effects. This theory states that there are several different groups of energy levels, or bands, in which the electrons of a solid material may exist. For our purposes, we can picture these energy levels as being divided into: (1) a valence band of low lying energy levels, and (2) a conduction band of high energy levels, separated by (3) a forbidden band, or gap.

Electrons in the valence band may be thought of as bound electrons whose freedom of movement is very restricted, whereas electrons in the conduction band may be thought of as being able to move about freely without restriction. In a good electrical conductor like a metal, many electrons are present in the conduction band, whereas in an insulator most of the electrons are restricted to the valence band, with a negligibly small number in the conduction band. A semiconductor has electrical properties intermediate between those of an insulator and a conductor. In an insulator, the forbidden gap between the conduction band and the valence band is much wider and harder to cross than in a semiconductor. It is consequently easier to make a semiconductor conduct electricity (i.e., it takes less work to move electrons from the valence band into the conduction band) than it is for an insulator. But if enough energy is put into a system, exciting electrons into the higher energy conduction levels, even a good insulator can be converted into a conductor. Thus, at high temperatures, thermal energy will convert some materials from non-conductors into conductors by exciting electrons into the conduction band. Energy absorbed from radiation can exert a similar effect.

A typical example of a purely ionic type of compound is a salt such as sodium chloride. From an atomic point of view, such a compound consists of a fixed network of positively and negatively charged ions held together by strong electrostatic forces. Ordinarily no electrons exist in the conduction band of such materials, and they are good insulators. Fast neutrons produce atomic displacements by collisions with the lattice ions, resulting in the interstitial-vacancy type of radiation damage. Conductivity is increased as a result, due to the greater number of vacancies present during and after irradiation. In addition, a new type of lattice defect is produced. With metals, it will be remembered, the energy transferred by ionization and excitation is degraded into heat; with an ionic crystal, however, electrons ejected during ionization processes may become trapped at certain imperfections in the crystal lattice, producing coloration centers known as "F-centers." Such optical effects may be more or less permanent, depending on post-irradiation treatment; if the crystal is annealed by heating, the absorbed energy stored in the form of trapped electrons may be released. Similarly, elevated temperatures enhance the probability of recombination between interstitials and vacancies.

A great number of inorganic compounds have chemical bonds which have mixed ionic-covalent characteristics. Typical of these are ceramics such as beryllium oxide and aluminum oxide, glasses such as the silicates and borates, and certain minerals such as mica. In general, the radiation stability of these materials is less than that of metals. For example, a neutron exposure of about 10^{20} neutrons/cm^2, which in most metals would produce barely perceptible changes, may cause appreciable changes in many of these materials. The principal mechanism is again

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Sometimes an exception occurs which cannot be explained so easily. An interesting example is the dimensional instability of metallic uranium when irradiated, a peculiar result which is most important in the reactor field. Upon prolonged irradiation, a sample of pure uranium can more than double its length. Although this dimensional change is undoubtedly connected with the anisotropic nature (unequal properties in different directions) of the uranium crystals, a complete explanation of the mechanism involved is still lacking.

through atom displacement, with changes in density, thermal conductivity, and electrical conductivity resulting from the increased lattice disorder. Color centers are likewise formed in many cases. A glass sample container exposed in a reactor, for example, may come out deeply colored, appearing almost black in some cases*. Prolonged exposure of glass to reactor radiation results in progressive deterioration, leading eventually to fracture.

Typical of the inorganic materials which are essentially covalent in structure are the elements carbon (both diamond and graphite), silicon, and germanium, as well as compounds such as silicon carbide, indium antimonide, and zinc oxide. Of these, carbon illustrates in a striking manner the effect of structure on properties of a material. Graphite is a form of carbon in which the carbon atoms are arranged in flat, parallel planes. Each carbon atom within a plane is attached by covalent bonds to three other atoms in that plane in a two-dimensional hexagonal arrangement; the planes themselves are too far apart to permit any chemical bonding between carbon atoms in adjacent planes. In diamond, on the other hand, each carbon atom is covalently bonded to four other carbon atoms situated at the corners of a regular tetrahedron; the closely packed, three-dimensionally bonded diamond crystal can thus be pictured as a single large molecule. This difference in structure is responsible for a great difference in properties of these two forms of carbon. Graphite is soft, with good lubricating properties, and has a weak grey-black metallic luster, whereas diamond is extremely hard, highly abrasive, and is clear and transparent. Graphite is a good conductor of heat and electricity, being about intermediate between a metal and a semiconductor in this respect, whereas diamond with its tightly bound electrons is a good insulator.

Both the electrical and thermal conductivity of graphite decrease upon irradiation. These effects are somewhat self-limiting, a matter of considerable importance in the technology of graphite-moderated power reactors; as the irradiation proceeds, an increase in temperature leads to an increase in the rate of annealing of the radiation-produced defects. Diamond, being an insulator, exhibits a somewhat different electrical behavior than graphite upon irradiation. The excitation of electrons to the conduction bands results in a transient decrease in resistivity; in an electric field, these excited electrons carry a current, which with proper amplification can then be used to measure the radiation. Diamond radiation counters have been utilized in the laboratory for this purpose. Permanent damage also results; since diamond is an insulator, some of the excited electrons can become trapped at lattice defects, and typical F-center coloration of the diamond occurs. Heavily irradiated diamonds turn almost completely black. Atom displacement also causes permanent damage in diamond.

Although silicon and germanium have the same crystal structure as diamond, they behave differently. Instead of being insulators, as one might think, these two elements, along with compounds like indium antimonide, are well-known semiconductors, which are finding wide application today as transistor devices. Transient radiation effects in such materials are well known. Irradiation with gamma rays, for example, easily excites electrons into the conduction band, resulting in appreciable leakage currents; this effect quickly disappears upon removal from the radiation field. Permanent effects are usually produced through the process of atom displacement. Because of the sensitivity of semiconductors to impurity atoms, transmutation processes in these materials can also lead to appreciable radiation damage. As described previously, absorption of a neutron by an atomic nucleus can lead to an energetically unstable combination which proceeds to stabilize itself by radioactive decay, resulting in formation of a new element. The new atom finds itself in a strange environment and becomes a lattice defect. In a material which contains a constituent with a high cross-section (or probability) for neutron absorption, this effect is quite important. For example, indium is an element with a high thermal neutron absorption cross-section; exposure of a semiconductor such as indium antimonide to thermal neutrons results in transmutation of indium atoms into tin atoms, which then become impurity atoms lodged in the semiconductor lattice*.

Organic Materials

At the opposite extreme from the metals are the organic compounds, which as a class are the least stable of all materials in a radiation field. This category includes plastics, elastomers, petroleum products, and many others. In these compounds, the atoms are held together by strong exchange forces arising from a mutual sharing of electrons. This type of bonding is called a covalent bond. Most gases and liquids, as well as the organic compounds which include most of the insulating materials in use today, are held together with this type of bond.

Unlike the metals, these compounds are very noticeably affected by ionization and excitation processes. The energy required to break a covalent bond is always less than the energy required to ionize a molecule. Consequently, when a molecule is ionized by radiation and subsequently recombines with an electron, an amount of energy equal to the ionization energy is released within the molecule and bonds may be broken. Absorption of energy by the excitation process may also lead to bond breaking. In either case, the end effect is chemical; the

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**For this reason, special types of radiation-resistant glass must be used in the viewing windows of the hot cells where highly radioactive materials are handled by remote control. Many of the early windows had to be discarded because of radiation-induced browning, which reduced visibility to the point where no further work could be carried out.*

**A notable example of build-up of foreign atoms in a material is found in nuclear fuels. In metallic uranium, the process of fission results in the formation of foreign fission product atoms in the lattice, which very noticeably affect the properties of the uranium.*

molecules which give that material its identity are broken, and new chemical species are formed within the material. Covalent compounds are susceptible to all ionizing radiation, including neutrons; the effect of the latter in producing atom displacements is important not because of the vacancies or interstitials produced, but in the secondary ionization and excitation processes caused by the recoiling atoms.

The study of the new chemical species which are produced, and their subsequent reactions, is known as radiation chemistry. In most simple gases and in pure water (which, like organics, are covalently bonded), these new chemical species are not given a chance to build up to any appreciable concentrations. Back reactions set in to re-form the original molecule, and the point of equilibrium in the system (where the decomposition and reformation rates become equal) is usually not far removed from the composition of the original material. Thus, in a mixture of nitrogen and hydrogen exposed to radiation, equilibrium is reached when only a few percent of ammonia is formed; no further change takes place on continued radiation. In the case of carbon dioxide, which is used as a gaseous reactor coolant in the huge atomic-powered generating stations now operating in England, the equilibrium is so close to pure carbon dioxide that no apparent reaction seems to take place. It is likewise very difficult to detect any changes when pure water is irradiated*.

In organic materials, however, the situation becomes much more complicated. This class of covalent compounds undergoes more complex reactions than the simple gases or pure water. Back reactions to re-form the original molecules occur either to only a slight extent or not at all; no equilibrium is reached, and continued irradiation produces continued chemical change. In most cases, these changes are not beneficial, but result in deterioration of the original material. For example, if a hydrocarbon such as a lubricating oil is irradiated, it is found that both polymerization (formation of larger molecules) and degradation (breakdown into smaller molecules) take place; considerable quantities of hydrogen gas are also evolved. Almost any hydrocarbon after prolonged irradiation is converted into a complex mixture containing not just a few, but many hydrocarbons. The same complex and essentially irreversible reactions are characteristic of almost all other types of organic materials. It is for this reason that living creatures, the most complex of all organic systems, are especially susceptible to radiation.

To illustrate: When gaseous methane, the simplest of the hydrocarbons, is irradiated, the primary chemical change is the breaking of a carbon to hydrogen bond:

$$CH_4 \rightarrow CH_3 + H \qquad (1)$$

The resultant species formed are the methyl radical and a hydrogen atom. These are extremely reactive, and if no impurities are present in the system, will react with each other:

$$CH_3 + CH_3 \rightarrow C_2H_6 \qquad (2)$$

$$H + H \rightarrow H_2 \qquad (3)$$

$$CH_3 + H \rightarrow CH_4 \qquad (4)$$

that is, approximately one-third of the products formed in reaction (1) will immediately react to re-form the methane molecule (4), while the remainder react to form the stable chemical molecules ethane (2) and hydrogen (3). But the ethane is also susceptible to radiation-induced bond breaking:

$$C_2H_6 \rightarrow C_2H_5 + H$$

The ethyl radical (C_2H_5 being a reactive species can react with the hydrogen atom to re-form ethane, or it can join together with another ethyl radical to form butane:

$$C_2H_5 + C_2H_5 \rightarrow C_4H_{10} \qquad (6)$$

or with a methyl radical to form propane:

$$C_2H_5 + CH_3 \rightarrow C_3H_8 \qquad (7)$$

The butane and propane are also subject to radiolysis, and as the process continues, higher hydrocarbons are formed until eventually a sticky liquid appears at very high dosages. If one starts with gaseous ethane, a liquid product is formed quicker than with methane—and, of course, methane will also be formed as one of the products. It is clear that when even a simple molecule like methane is irradiated, the probability of its being re-formed in a back reaction may at first be quite high, but as the radiolysis proceeds, this probability gets less and less, and the decomposition becomes essentially irreversible.

This build-up of carbon chains having a higher molecular weight than the starting material is known as polymerization. When the starting materials are simple compounds, such as the methane or ethane in the examples above, the changes subsequent to bond breaking are relatively straightforward and unambiguous. But if one starts with high molecular weight polymers (such as the plastics and elastomers so widely used as insulating materials), the changes become more numerous and complex. Irradiation of the long polymer chains produces a variety of fragments, capable of reacting in different ways to produce phenomena such as cross-linking, degradation, unsaturation, and gas generation. Whether any of these processes predominates over the others in a given material depends on the chemical structure of the compound involved.

Cross-linking is a process which leads to the joining together of two or more of the long chain polymer molecules. Figure 1 shows how such a process might occur in irradiated polyethylene. The steps leading to the formation of this cross-link may be pictured as follows: (1) Energy is transferred to molecule I by excitation or an ionization process, as previously described. (2) In either case the excess energy possessed by the now unstable molecule is utilized to break the bond between a carbon atom and a hydrogen atom (C-H). (3) When a C-H bond is broken, a free hydrogen atom is produced; because of its chemical activity this is able to extract a neighboring hydrogen atom from molecule II

With aqueous solutions, however, this is not so; appreciable decomposition of the water may occur, releasing large quantities of gaseous hydrogen and oxygen, an explosive mixture. This is particularly true in the homogeneous type of reactor, where the uranium fuel is dissolved in an acidic aqueous solution, and presents serious operating difficulties.

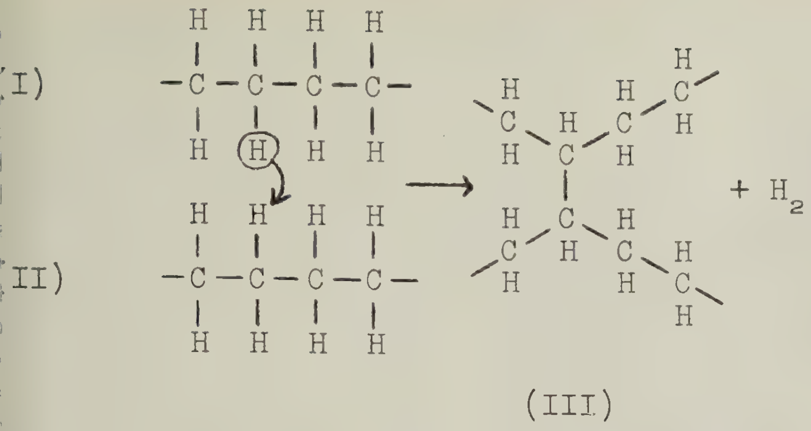


Figure 1, cross-linking in polyethylene. This is schematic only; the actual polymer molecule contains thousands of carbon atoms bonded together.

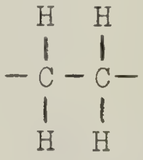
to form a molecule of hydrogen gas H_2. (4) Molecules I and II now become linked together through the unsatisfied carbon valences at the positions previously filled by the hydrogen atoms to form the larger molecule III. This process may continue repeating itself until a gigantic, three-dimensional, network type of structure results.

A limited amount of cross-linking is often beneficial, giving the material improved physical and chemical characteristics. For example, irradiated polyethylene shows improved heat resistance and chemical inertness, the extent of the improvement depending on how tightly the molecules have become tied together during the cross-linking process. In fact, irradiated polyethylene has been suggested for use as high temperature electrical insulation. Other materials also cross-link under irradiation, with a similar improvement in properties; these include polystyrene, nylon, neoprene, natural rubber, and certain of the silicones. For a given amount of radiation, the degree of cross-linking in different materials may vary widely, depending on the initial size of the polymer molecules and their chemical structure. Whether or not the cross-linking is beneficial, as in the case of polyethylene, depends on the application involved. Rubber, for example, loses its elasticity because of cross-linking, and in most cases this destroys its usefulness. It should be emphasized that the improvement shown by many materials is only for limited doses of radiation; prolonged irradiation will always lead eventually to deterioration of any organic material.

The breakdown of a polymer chain is known as degradation, and takes place when carbon-carbon bonds are broken. In some materials degradation occurs simultaneously with cross-linking, and the resultant properties depend in a rather complex manner upon the relative rates of the two processes. However, other polymers begin to degrade immediately upon irradiation, with little or no sign of cross-linking. In "Lucite" (polymethylmethacrylate) both the main polymer chain and the side chains are broken down; the plastic turns brown, undesirable carbon dioxide gas is liberated and forms small bubbles within the solid plastic, and cracks develop throughout the material. "Teflon" (polytetrafluoroethylene), one of our most useful plastics, also degrades when irradiated; in fact, this material, which owes its usefulness to its remarkable chemical inertness, is so sensitive to radiation that it must be classified as one of the poorest of all materials from the standpoint of radiation stability. The breakdown products of irradiated Teflon are quite corrosive, and can prove injurious to nearby metal components. Butyl rubber also degrades when irradiated, changing from a solid elastomer to a sticky liquid in the process. "Kel-F" (chlorotrifluoroethylene), polyvinyl chloride, poly-alpha-methylstyrene, and vinylidene chloride are other well-known polymers which degrade upon irradiation.

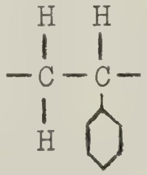
These chemical changes and structural rearrangements which occur in organic materials will seriously and permanently affect their desirable properties. Chemical reactivity, viscosity, specific gravity, tensile strength, shear strength, transparency, elasticity, electric strength, and resistivity are all affected. Furthermore, it takes only a small dose in many cases to produce a noticeable effect. In general, the dose of radiation necessary to cause damage in organics may be several orders of magnitude less than what is necessary to produce measurable effects in other materials. For example, in a high molecular weight polymer like Lucite, where a single molecule may contain a hundred thousand or more bonds, a relatively small number of bond breaks from a comparatively small dose can result in significant changes in the physical properties of the material.

Although as a class the organics exhibit the lowest resistance to radiation of all materials, considerable variation in radiation stability still exists within the group. This is based in large part on chemical composition. For example, the presence of an aromatic phenyl group in a molecule will greatly increase its stability toward radiation. In polyethylene, the repeating structural unit is shown in (a);

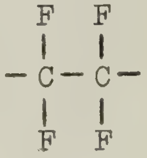


$$-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-$$

(a)



(b)



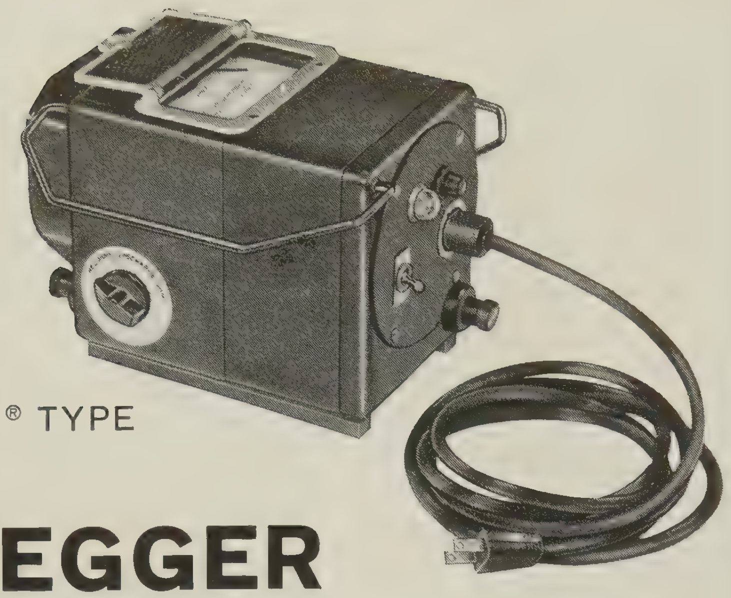
$$-\overset{F}{\underset{F}{C}}-\overset{F}{\underset{F}{C}}-$$

(c)

substitution of a phenyl group for one of the hydrogen atoms to give polystyrene (b) increases the radiation stability almost a hundredfold. In some way which is not yet clear, the highly resonant structure of the phenyl ring is able to absorb radiant energy and dissipate it without undergoing decomposition. However, if fluorine atoms are substituted for the hydrogens in (a) to give polytetrafluoroethylene (c), the radiation resistance is very much weakened; the strong carbonfluorine bonds prevent cross-linking, and breaking of the weaker carbon-carbon bonds leads to rapid degradation.

An important characteristic of irradiated organics is that the radiation effects produced in a given material are proportional to the total energy absorbed, regardless of the type or quality of the ionizing radiation employed. It therefore follows that a compilation of radiation effects data on organic materials, and a correlation of the results obtained, can best be accomplished on the basis of energy absorbed by the material. Needless to say, this principle, together with such a compilation, is invaluable to the design engineer when he attempts to estimate the probable lifetime of a material in a given radiation field.

In summary, it can be said that as a class metals are the most highly resistant of all materials to radiation, while organic compounds are the least resistant. Intermediate is the inorganic group, which in turn can be subdivided into ionic salts, ceramics, glasses, minerals, and semiconductors. Radiation resistance within the inorganic group varies widely, ranging from high (ceramics) to low (semiconductors). Within the organic group, there is a similar spread, the aromatic compounds being most stable. This variation leads to some overlapping between groups; for example, for some applications (e.g., amplification) semiconductors are even more susceptible to radiation than the organics. Permanent effects in materials are caused by atom displacement, introduction of foreign atoms in the crystal lattice through the mechanism of transmutation, or the breaking of chemical bonds and the subsequent formation of new chemical species in a system. In metals and inorganic materials, atom displacement and the introduction of foreign atoms are responsible for the observed effects; in organic materials, irreversible chemical changes are responsible for the permanent damage.



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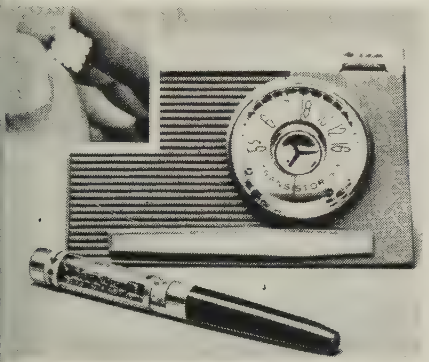

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Ice and snow will be removed from sidewalks of the new Eastwood Shopping Center, Pittsburgh, by heat generated from vinyl insulated wiring imbedded in the concrete. The heating wire is taped to reinforcing wire in "loop" fashion prior to pouring the top layer of concrete over the units. Easily installed, with low operational cost, the heating units are called Chromalox Thermwire by the manufacturer, the Edwin L. Wiegand Co., Pittsburgh. "Geon" vinyl insulation is supplied by B. F. Goodrich Chemical Co., Cleveland.

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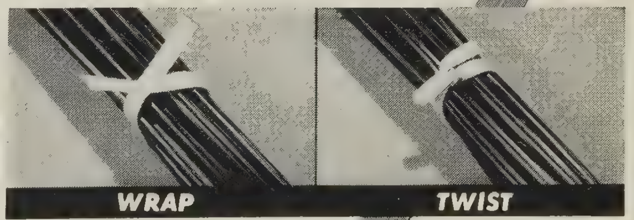

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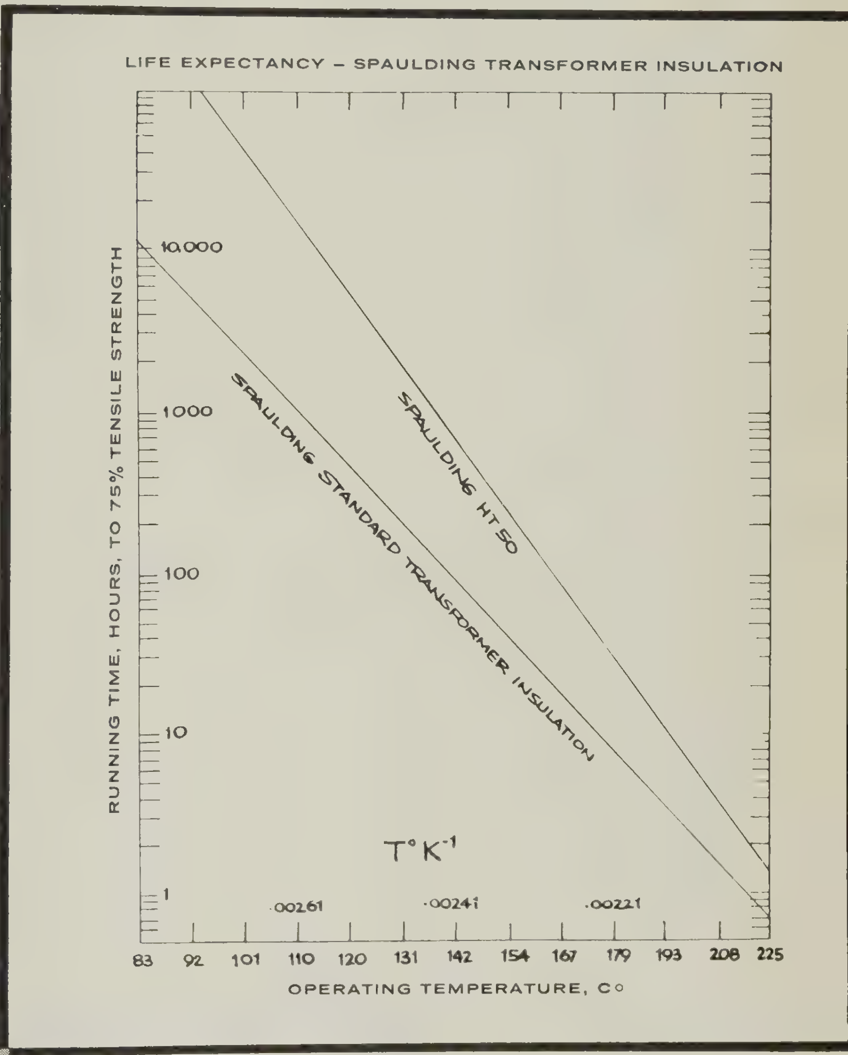

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Pixilated Patents

By Mike Rivise

(Thirty-eighth in a series of odd and interesting inventions in the electri-onics field from the files of the U. S. Patent Office.)

If you've never heard a barker at your local carnival shout, "Step right up and 'shute' a pig alive!", it's probably because pigs thought very little of the activity covered by patent No. 1,339,871, an amusement device patented by John Van Camp in 1920.

His idea was a refinement of the old baseball-milk bottle game. When a customer hit the target, an electric light was turned on in a pigpen behind the target and the door of the pen was opened. The light was supposed to frighten the pig sufficiently to cause him to run from the pen, climb a ladder, slide down a chute, somersault onto a mattress, and then run back to the pen . . . only to repeat the whole procedure when another customer with an accurate throwing arm stepped up.

According to the patent description, "A flock of live pigs is placed in the space below the secondary floor and in front of the rear fence, and this space becomes the pigs' home. The pigs are, of course, more or less trained, and when the amusement device is in operation an attendant takes a pig from the home and places the pig in one of the pens, and then another pig in another pen, and so on until each pen has a pig. Doors are formed in the wall at the back of the pigpens so that the attendant may open the door and place the pig in the pen. The pens are normally dark and the pig is restless and homesick. A customer takes a certain number of balls and throws the balls at the openings 42 and every time a ball passes through an opening and strikes an actuator 38 the corresponding door 27, 28, 29, or 30 will be released and swung open, thereby illuminating the lamp within the pigpen, and the corresponding lamp on top of the pigpen, and the sudden illumination of the lamp will scare the pig more or less and the pig will rush out of the door and up the ladder 32 and slide down the chute 31 and turn a somersault from the chute and land upon the mattress 33, straighten himself up and make a rush for home, and the only avenue from the mattress space to the pig's home is through the tunnel 8."

It seems to us that after a few trips like this, home might not seem so sweet to the shaken porkers. Infinitely more amusement might then result from efforts to return them to their pens.

Fig. 1.

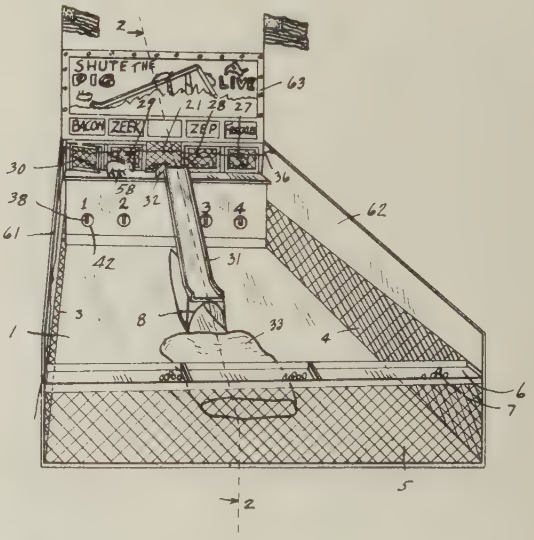
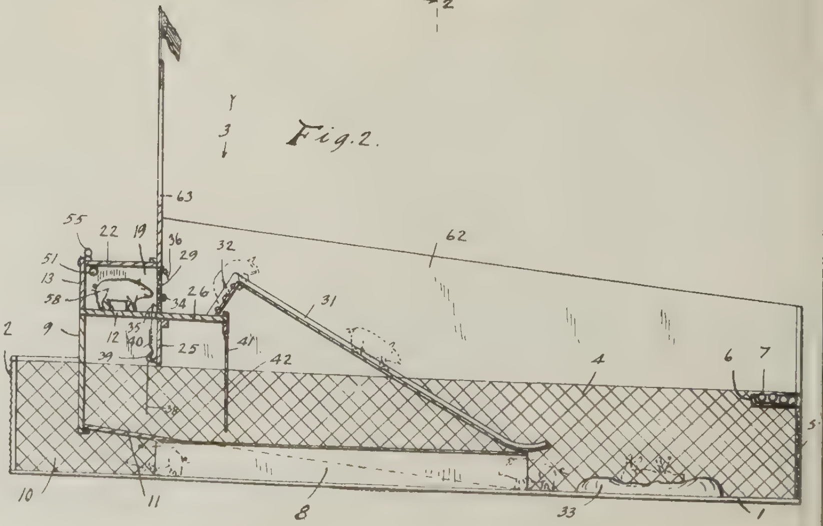


Fig. 2.



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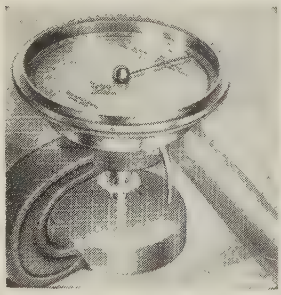

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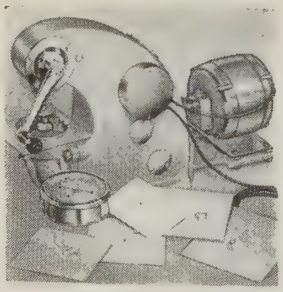

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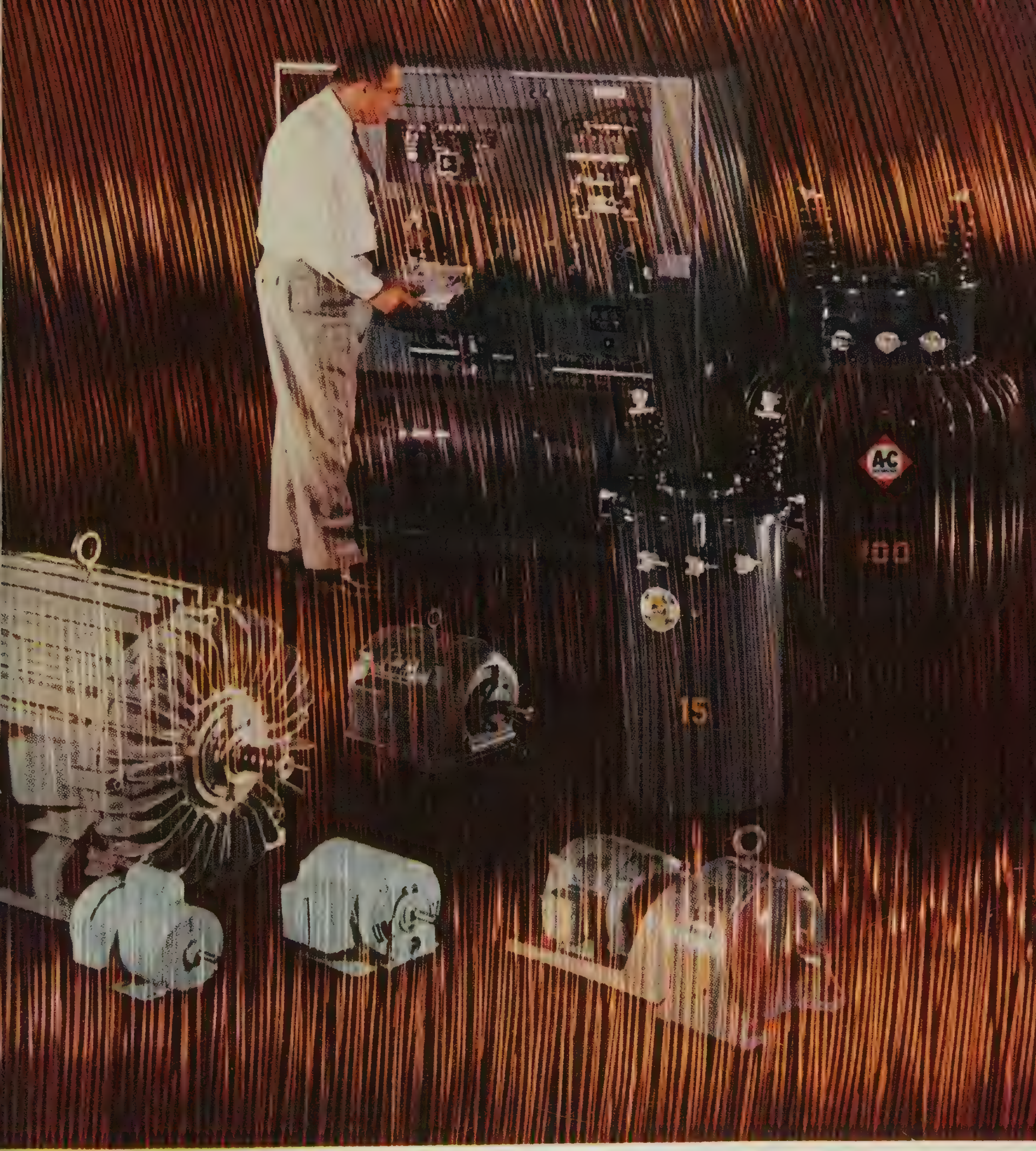

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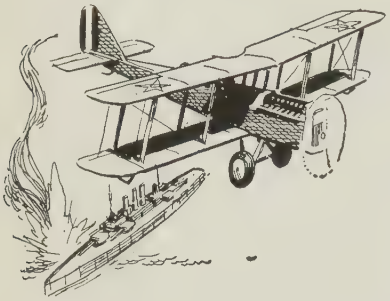

Admirals smiled when, in 1921, he claimed air power could sink battleships. Josephus Daniels, the Navy secretary, said he was "prepared to stand bareheaded on the deck of a battleship and let General Mitchell take a crack at me with bombing airplane."

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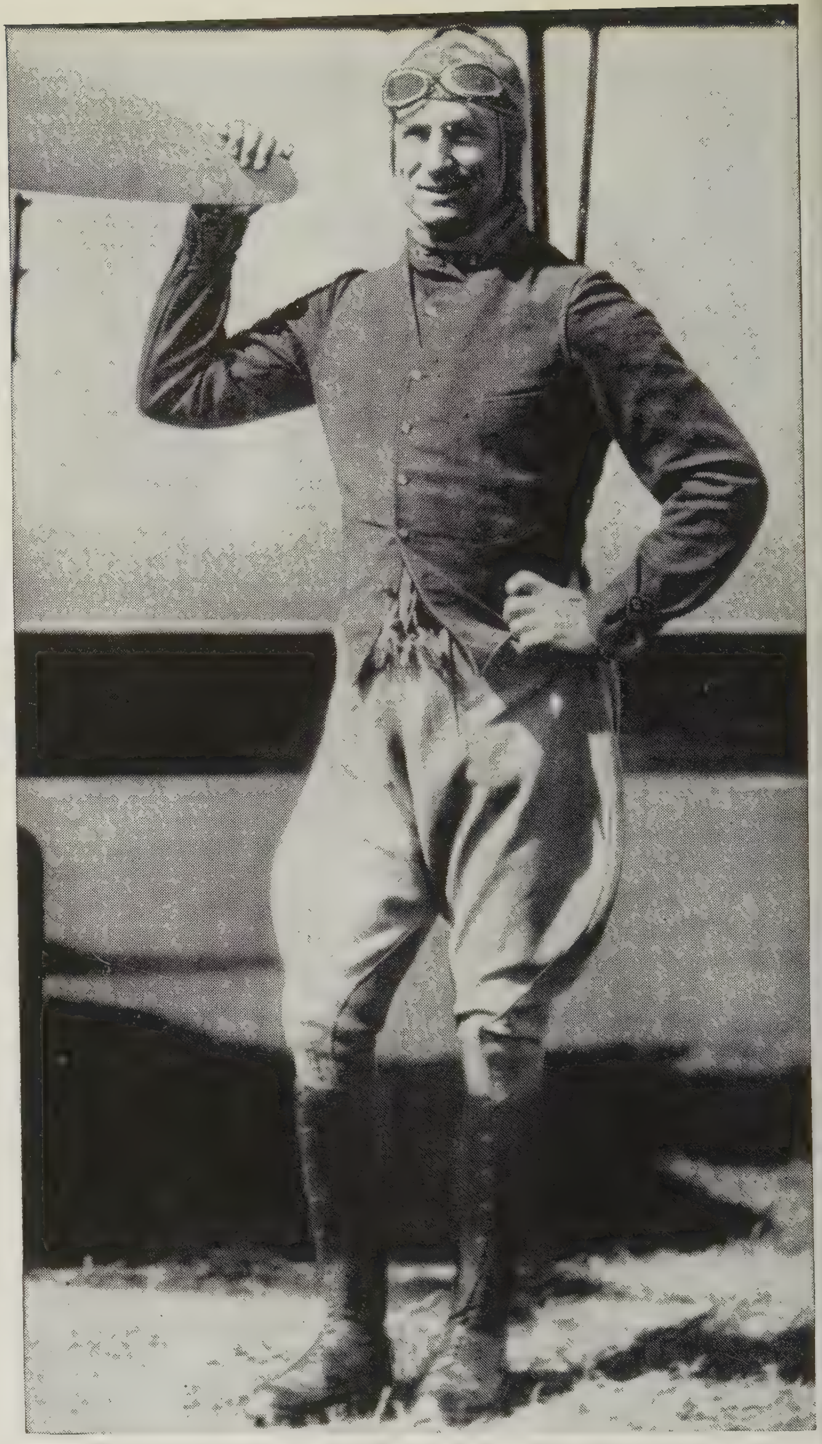

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Statistical Methods of Control for The Manufacture of High Voltage Stator Coils

By R. M. Sexton, Manager, Commercial Insulation Section, Services Engineering, Large Rotating Apparatus Department, Westinghouse Electric Corp., East Pittsburgh, Pa.

In the manufacture of high voltage stator coils for central station type machines there are many problems, not the least of which is establishing a satisfactory method for controlling the quality of the product. In speaking of the quality or quality level of insulation, we invariably come up against the fact that at the present state of the art there is no non-destructive test or combination of tests that will indicate with complete reliability what the electrical breakdown level of the insulation might be. This is essentially the crux of the problem, but fortunately, there are alternative methods which have proven to be a very satisfactory solution for the lack of this "complete" test.

The fact that throughout this article we will be discussing high voltage coils bears some discussion, too. Along with this descriptive term go other factors which are certainly pertinent. The majority of such coils are used by the electric utility industry for the generation of power. It is vital, therefore, that these machines, and the stator coils as an important component, have a high degree of reliability. It is because of this that additional expense is justified in the maintenance of a quality control program.

Because of the nature of the end product, the complete generator, there are also other characteristics which are distinctive of this particular type of coil. Some of these are:

1. The coils themselves are quite large —core lengths of 20 feet or more are not uncommon—and therefore, large areas of insulation are involved. With the increase in area, of course, goes the possibility of the increase in variability of the insulation wall itself.
2. It is possible for the insulating materials to vary more widely on this type of coil because more "bulk" is required and batch-to-batch variations are present which might not be a factor on smaller coils.
3. Consolidation of the insulation is also a factor which can be related to size since it is obviously more difficult to obtain true homogenity on larger and larger areas.
4. Possibilities of mechanical damage to the coils are also increased with size. Manipulation of some of the larger turbine generator half coils through the bore of the stator and into position for winding is getting to be considerably more than a simple step of two men picking the coil up and setting it into place.
5. With many of the newer insulation systems placing reliance on a chemical process, there is now a need for control of this process where perhaps none was needed previously.
6. Although there are many other individual factors which could be mentioned, many of them can be grouped together into the "human factor" classification. Manufacture of stator coils of this type is far from being an automated process. In fact, there is probably no other single component of a complete generator that places as much emphasis on individual operator skill as does the stator winding.

With the preceding introduction, it becomes evident that quality control measures are highly desirable, but that the problem needs a somewhat different approach than is used on mass produced, highly repetitive items. The basic techniques of statistical analysis continue to apply, however, and knowledge of these is essential to the complete understanding of the program. As a first step, it is apparent that since the only known method of determining the quality level of the product, in this case the insulation, also involves destroying it, a sampling technique must be used. This is a technique widely used throughout industry for a wide variety of products and is used with a surprisingly high degree of reliability.

To a manufacturer, a statistical quality control program offers many advantages. One of these is the possibility of presenting graphically and quite dramatically a comparison of today's quality level to the desired level, as well as to what it was last week, last year, etc. This is what is known as the control chart method of analyzing data. Figure 2 shows a typical control chart for high voltage stator coils. Here is shown a desired central or standard level as well as upper and lower control limits. In this case the control limits vary from month to month because there is some variation in the number of coils produced per month. On a highly repetitive type of operation where the output is measured in many thousands, the control limits would be straight lines. A more complete reference on the subject of control charts is given in the American Standards Association publication Z1.1-1958 & Z1.2-1958.

The quality control chart can be a very useful tool to management in several ways. It gives a picture of the long time and short time trends in manufacturing variations. An obvious goal is continued improvement, and the difference between opinions in this regard and facts can be demonstrated on the chart. It is also desirable, should the quality level start to drop for any reason, to first determine this fact as rapidly as possible and then, secondly, to take appropriate action to correct the trend. Here again the control chart is a most useful tool.

An additional benefit of the control chart method is the opportunity it provides for large scale comparisons of insulation systems. In the last few years there have been many novel insulation systems introduced, most bearing distinctive trademarks, and it is hoped that these are a step forward in the progress of the industry. How can this be determined factually? Laboratory studies and investigations

Table 1—Typical Quality Control Data

Coil	Electrode Location	Hold Value, %
#1	1	104
	2	98
	3	92
	4	92
	5	102
	6	103
#2	1	105
	2	104
	3	106
	4	90
	5	100
	6	104
		$\bar{X} = 100\%$
		$\sigma = 5.7\%$

are an important part of such an analysis but these of necessity are on a limited scale. The control chart, however, if it is widely used in the manufacture of the new product, will tell with a high degree of reliability whether the product in the "as made" condition is better and more uniform than the previous product. It will not tell or forecast the condition of the product after use or aging. For this, the laboratory analysis and finally, service experience provide the answers.

With this background let us now look in greater detail at a specific approach to the problem of quality control procedures. One question which must be determined at the beginning is that of the sample size. From statistical analysis we know that more confidence can be placed in the results of studies made on large samples as compared to small samples. In this case, however, we are talking about a product which has both considerable physical size and expense and these must be considered in determining the size of the sample. A possible compromise is to keep the actual number of coils used for quality checks relatively small, but to get as many individual readings from them as possible. The system used by Westinghouse is based on this approach. Two coils are selected from each set of coils being manufactured and designated after processing as quality control coils. These coils are then treated in such a way that as many as six or more individual breakdown readings are obtained per coil, the electrode length per breakdown being eight inches and the electrode area being the product of this length and the coil periphery. The method of test used is a step-by-step type of breakdown although rapid rise or other standardized methods could be used. It is imperative, however, that as much information as possible be obtained from the samples.

In the discussion of sampling technique, it is important in this case (as it is in any case of statistical analysis) that the samples be selected at random. Selection of samples by a standardized pattern can lead to prejudiced results and nullification of the entire project. As is so often the case, however, there must be some compromise with theory and practice. Truly random selection of samples would indicate on occasion taking some of the last coils made on an order. From the practical standpoint, it is desirable to get the quality control data as soon as possible so that corrective action can be taken if the results indicate this is necessary. A middle ground has, therefore, been adopted wherein the samples are selected from the first one-third of the production total. In this manner, results become available sufficiently soon to make decisions about the acceptability of a specific production order.

Table 1 lists the results from a

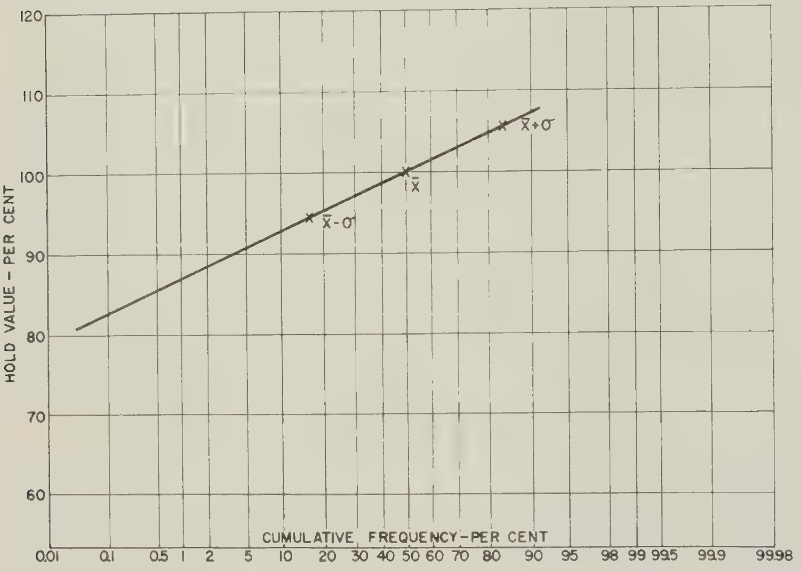


Figure 1, probability curve.

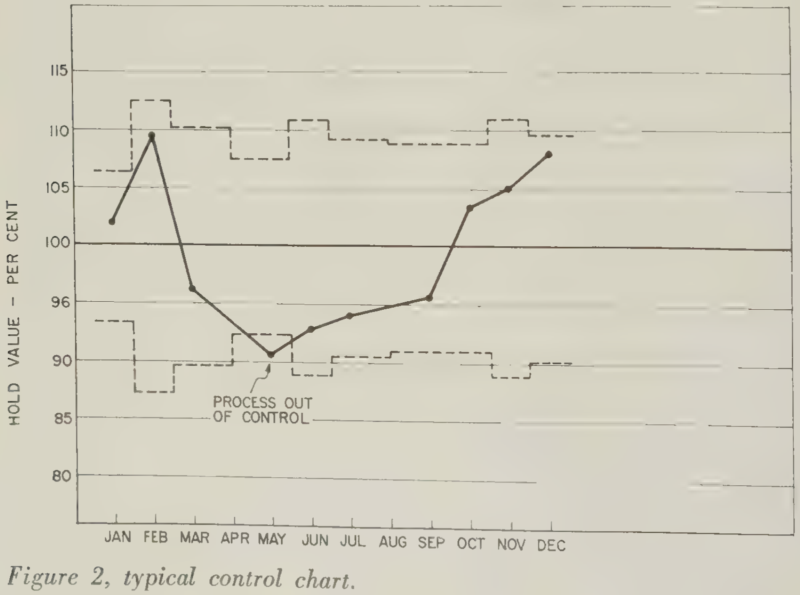


Figure 2, typical control chart.

typical series of tests on two high voltage quality control coils. The actual voltage levels have been converted to percent of the average obtained to simplify the illustration. Since a step-by-step voltage rise is used in this case, the values tabulated are termed "hold values" or the maximum level held for the full time period prior to failure. Table 1 also shows the arithmetic average ($\overline{X}$) and the standard deviation "sigma" (σ) for the particular set of values given. The method of calculation used in determining the standard deviation can be obtained in the American Standards Association bulletin mentioned previously or any standard textbook on statistics.

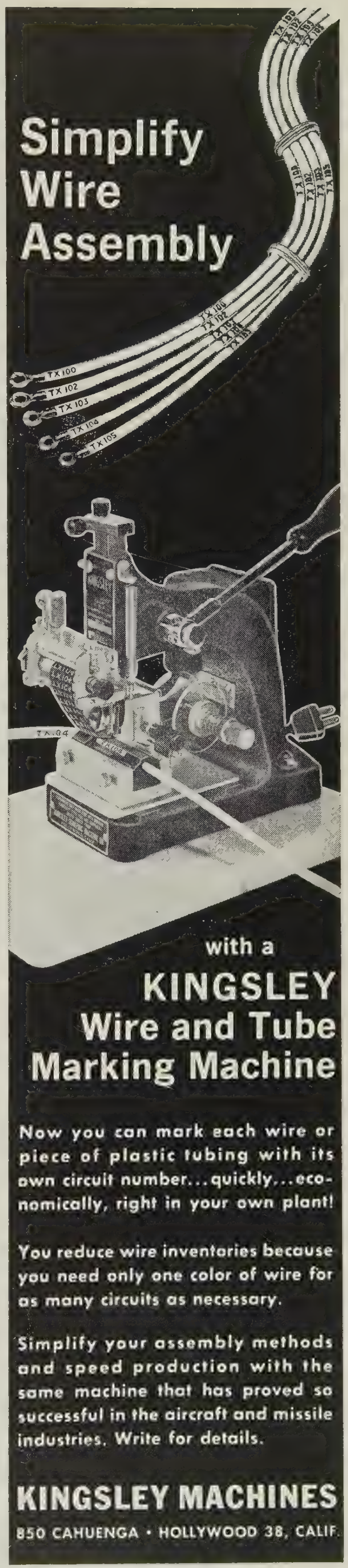
With the basic information given in table 1, a great deal can be learned about the characteristics of the set of coils from which the samples were taken. One widely used method is to plot this data on probability paper as has been done in figure 1. This is a graphical method of determining whether the quality level of the order being checked meets established standards. For example, in figure 1, if it has been determined that a minimum hold value of 90% is acceptable, then in this case approximately 3 to 4% of the coils being produced will be sub-standard. Conversely, if the minimum level is established as 80%, then only a slight fraction of 1%, practically an insignificant amount, will be unacceptable. The level of the curve as determined by the position of $\overline{X}$ and the slope of the curve go together to determine the reliability of any particular set or order.

Depending upon the type of product being produced, the standards may vary but the Westinghouse practice has been to maintain the lower level of the 3 sigma range (which includes more than 99.8% of the probable total values present) well above the acceptance test level for individual coils, a level which itself is well above the 2E+1 test level prescribed in ASA C50 for the completed winding. It is felt that such a quality level is necessary on important equipment of the type under discussion.

As mentioned previously, the control chart graphically illustrates the month-to-month variations. The point being plotted is the average of all the $\overline{X}$ figures obtained during a particular calendar month. The control limits are based on a 3 sigma variation and when the average for one or more months falls below the lower limit, it is obvious that consistent results cannot be obtained. It should be mentioned that in dealing with a product such as insulation, we are concerned generally only with the lower control limits. If the process is "out of control" on the high side, the product will not suffer although consistent results of this type will lead to speculation that the basic design is overly conservative or that established standards are not realistic.

With all the data available it is next essential to study and review it at regular periodic intervals. Such a review must be made with reasonable objectives in mind, particularly in regard to a balance between quality level as a separate factor and the economics of manufacture. It has been found that reviews each month are a necessity, and that on some occasions, particularly if the data shows the process out of control, the reviews need to be even more frequent. Along with the reviews there must be effective programs of corrective action when this is necessary. At times it may be desirable to sample more frequently or subdivide the program into more basic elements and the requirements along these lines can be developed as experience is gathered.

It is hoped that the preceding brief description gives some insight into a typical insulation quality control problem. Westinghouse experience with this approach has been exceptionally good. This is reflected particularly in the record of defective subassemblies (coils) encountered in manufacture. Prior to the institution of this program in 1947, the percentage of coil failures was on several occasions in excess of 10%. The quality control approach was successful in reducing this figure to the order of 1 or 2 percent. Still later, with the advent of new insulation, the percentage of coil failures was further reduced and for the past ten years has consistently been a small fraction of one percent month after month.



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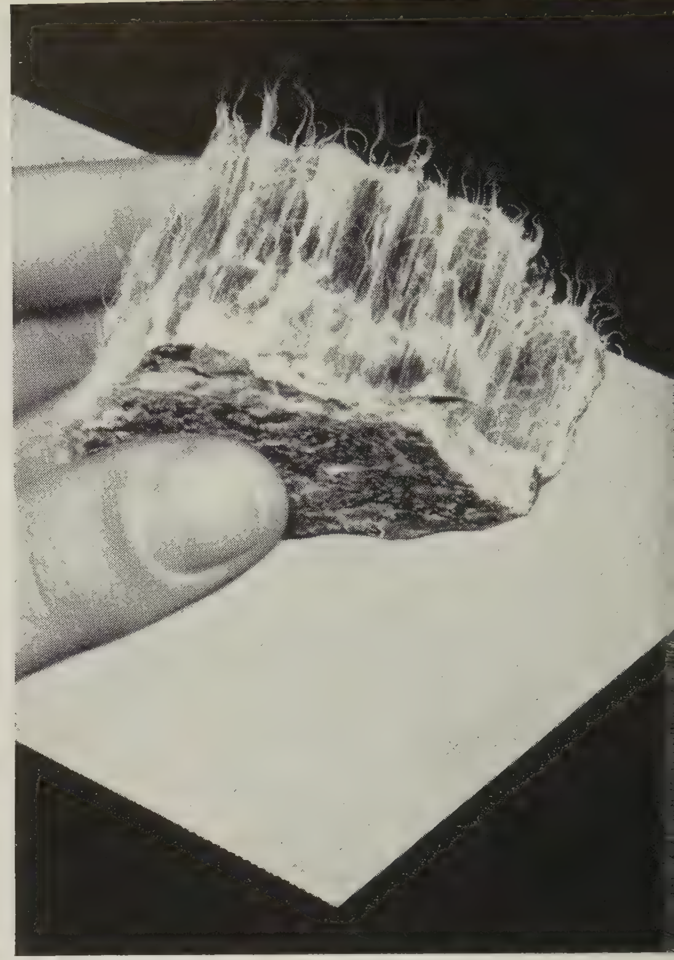

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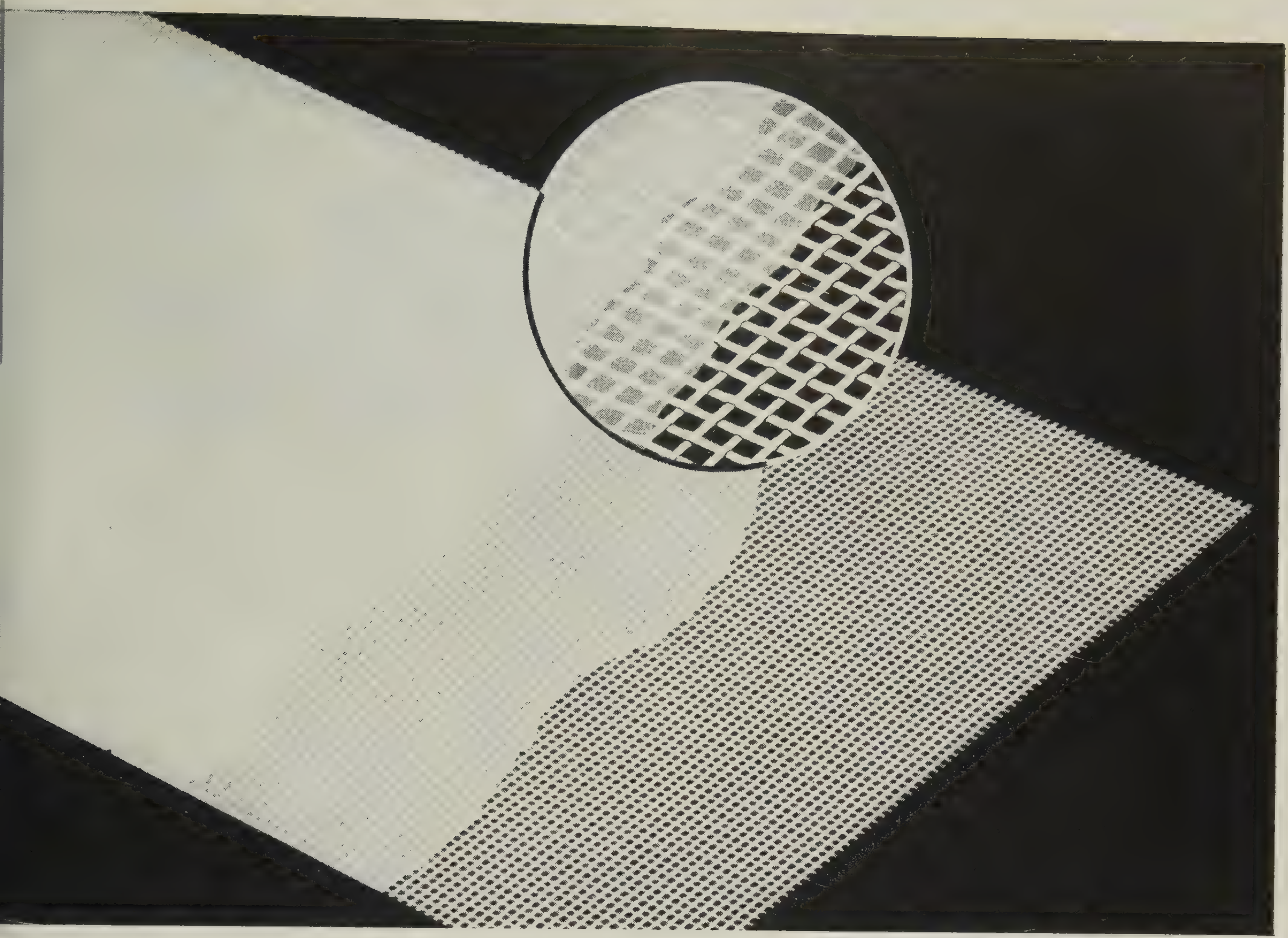

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Novel Multiple Specimen Holder Reduces Variables In Magnet Wire Thermal Investigations

By Lee M. Johnson and Maxwell E. Sharp, U. S. Naval Research Laboratory, Washington 25, D. C.

In recent years the investigation of thermal aging characteristics of round magnet wire has been standardized by the prescribed methods outlined in the AIEE Test Procedure No. 57. This procedure specifies a standard test sample now known as the twisted pair specimen. Due to the randomness of the temperature-life data, 10 specimens are indicated as the minimum number of samples to be evaluated at any given test temperature. Thus, for a typical four-point temperature-life curve, this requires a minimum of 40 specimens. It becomes evident then that this number of specimens offers a problem in handling and experimental processing.

The present method necessitates the handling of each individual specimen throughout the prescribed testing procedure of heat aging and voltage stressing. Two variables (both mechanical) are unavoidably introduced with this method.

First, the specimens are subjected to possible mechanical damage from handling as they are removed from the container (which may be in the form of a box, tray, or wire basket), and placed on the voltage stressing apparatus, and later returned to the container.

Secondly, adhesion damage will be experienced with some enamels when the specimens are placed together or on top of each other in the container. Adherence of the wires is due to the plastic flow of the wire enamel during the earlier stages of thermal aging. Because the specimens are tested singly, it is necessary in the case of adhered twists to pull them apart with consequent rupturing of the insulating film. This condition results in an actual rupturing of the insulating film as the wires are pulled apart at room temperature. One method calls for bundling the specimens together with glass fiber sleeving, a practice which increases the severity of mechanical damage due to specimen bending and increased adhesion.

As a solution to these problems, the multiple twist specimen holder and mercury electrode stand, as illustrated in figure 1, were designed by this laboratory. This holding fixture permits mounting of the specimens in a fixed permanent position, thus protecting them from the damaging conditions previously described. The leads of each of the 10 twist specimens are placed between silicone-glass laminated spacers (see figure 2 for specifications of materials, dimensions, etc.) that are in turn clamped together within a protecting metal cover with two open sides. This assembly can then be handled as one unit, eliminating the need of a container or tray. It can be put directly in the aging oven, removed, and placed on the voltage stressing apparatus without any handling of the individual specimens.

The multiple specimen holder offers other advantages as follows:

1. The open sides of the cover provide more adequate circulation of air than a box or other similar container, thus reducing the temperature gradients within the specimen area.

2. Once the specimens are clamped in the holder, the possibility of accidentally mixing with other batches of specimens or the loss of specimens is eliminated.

3. The time required to voltage stress the specimens can be reduced to one-tenth the conventional time when the holder is used with a multiple tester of the type illustrated in figure 3. Wiring diagram and parts list may be obtained from the authors upon request. This tester uses neon lamps and provides simultaneous testing of 10 specimens by pushing the one activating button. The protruding leads of all previously failed specimens can be easily bent over to prevent contact with the mercury electrode, thus eliminating repetitious lighting of the neon lamps which provides for easier recording of new failures.

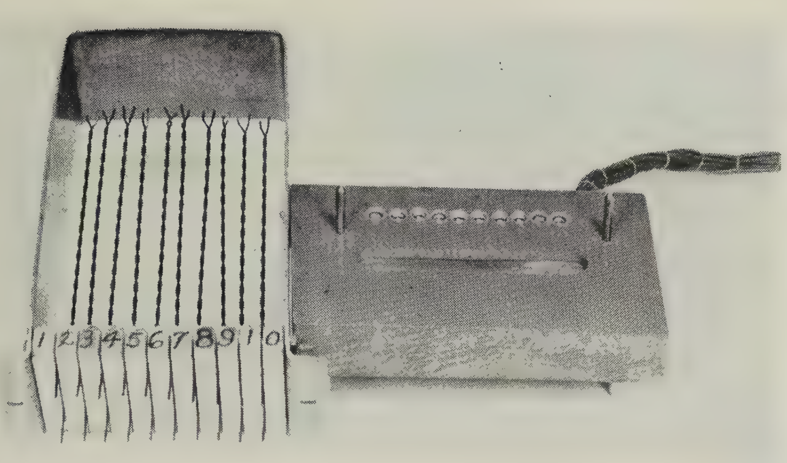

Figure 1, multiple twist specimen holder and mercury electrode stand.

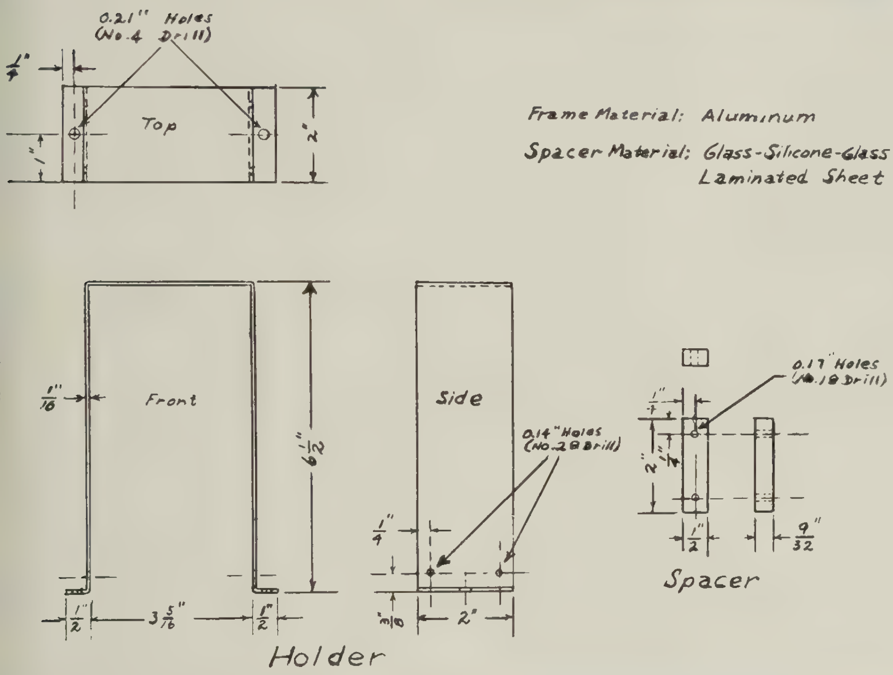

Figure 2, working drawing of multiple twist specimen holder.

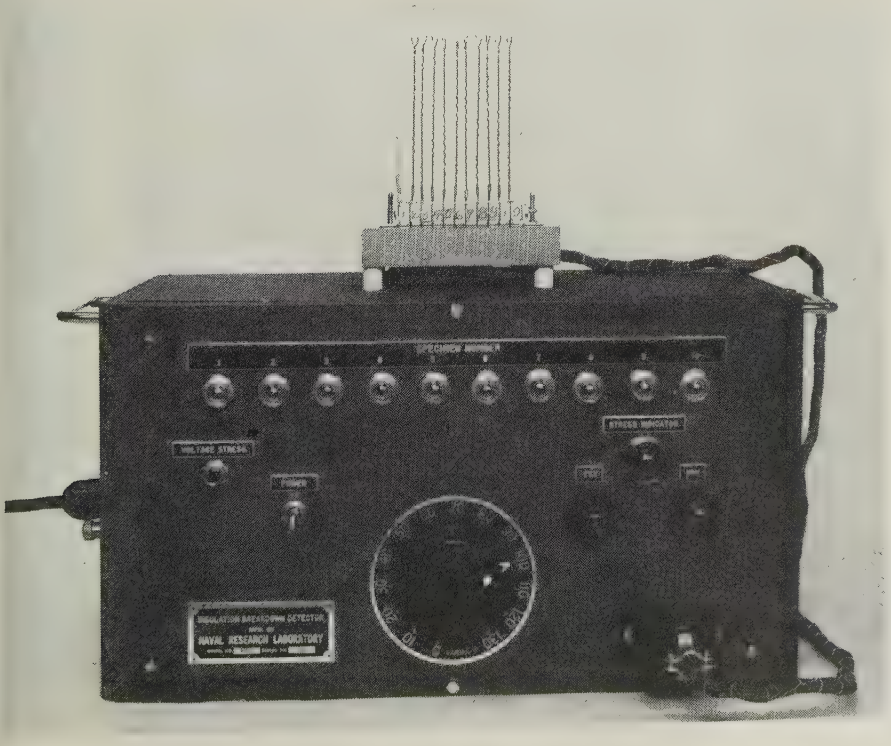

Figure 3, specimen holder and multiple insulation breakdown detector.

New Publications

Books

Russian Patents Gazette. A monthly publication containing concise abstracts of Russian patents arranged under convenient subject headings. Annual subscriptions are accepted for the whole publication ($120) or for either the General Mechanical & Electrical Section or the Chemistry & Chemical Engineering Section only ($80 each). Order from the Technical Information Co., Chancery House, Chancery Lane, London, WC2, England.

Value Engineering — 1959. Contains complete versions of all technical papers presented at the October 1959 Electronic Industries Association Conference on Value Engineering. Papers cover basic concepts and philosophies, techniques, application, and relationship with other work areas. Customer, manufacturer, and vendor viewpoints are represented. 165 pages, 6″ x 9″, illustrated, hard cover, $6. Engineering Publishers, P. O. Box 2, Elizabeth, N.J.

Resistance and Resistors, by Charles L. Wellard. Reference and guidebook presents basic aspects of resistance and detailed descriptions of each type of resistor. Tables include most manufacturers' data. Charts and graphs cover power and voltage ratings, materials used, and applications. Reliability and precision films and their preparation are also discussed. 272 pages, 6″ x 9″, 79 illustrations, $8.50. McGraw-Hill Book Co., 330 W. 42nd St., New York 36.

Connecting Induction Motors: Operation and Practice, by A. M. Dudley and Samuel F. Henderson. This revised edition contains new chapters on part-winding starting connections, single-phase connections, multi-speed polyphase motors, and the use of performance characteristics information on the name plate for maximum potential use of the motor. Fourth edition, 425 pages, 6″ x 9″, 433 illustrations, $13.50. McGraw-Hill Book Co., 330 W. 42nd St., New York 36.

Modern Electronic Components, by G. W. A. Dummer. A comprehensive summary of essential data on electronic components designed to help the user to understand the basic characteristics of components and to enable him to choose the best component for his purpose. $15. Philosophical Library Inc., 15 East 40th St., New York 16.

Plastics Safety Handbook, jointly produced by The Society of the Plastics Industry Inc. and the National Safety Council. In addition to general safety topics, it discusses the latest safety methods and practices relating to many processes in the plastics industry. More than 200 pages and 128 photographs, charts, diagrams, tables, and report forms. $5 plus postage. SPI, 250 Park Ave., New York 17.

OTS Reports

The following reports may be ordered by number from the Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D.C.

PB 151657, Thermoelectricity Abstracts (May 1959), 112 pages, $2.50.

PB 151810, Thermoelectricity Abstracts (Aug. 1959), 81 pages, $2.25.

SB-400, Plastics-Polymer Research. This publication is the first of a series of OTS Selective Bibliographies which will replace Catalogs of Technical Reports. 10¢.

Navy Reliability Design Handbook Supplements (formerly the *NEL Reliability Design Handbook).* Presents new information on materials, processes, and techniques as well as design aids. Basic handbook sells for $3. Recently resumed quarterly supplements are available at $2.25 per year or 75 cents per copy.

PB 151860, Perarylated Silanes: A Class of Stable Organic Molecule, by L. Spialter and C. W. Harris. Versatility of these materials and their resistance to high temperatures and radiation may lead to uses as adhesives, fibers, dielectric materials, plastics, and elastomers. 22 pages, 75 cents.

NEMA Publications

The following new publications may be ordered from the National Electrical Manufacturers Assn., 155 East 44th St., New York 17.

Analysis of 1959 Revision of National Electrical Code, 200-1959. Designed to assist users in comparing the 1956 and 1959 editions of the code. 50 cents.

SG 1-1958, Electric Power Connector Standards (revised). $1.80.

AB 1-1959, Molded Case Circuit Breakers. 40 cents.

BC 1-1959, Bituminized-Fibre Conduits and Fittings. 30 cents.

CP 1-1959, Shunt Capacitors. 50 cents.

HV 1-1959, Summary of Characteristics of Apparatus Insulators. 25 cents.

SM 30-1959, Gas Turbine Power Plants. Contains definitions; nomenclature; and information on rating and performance, accessories, preparation for shipment and installation, and weather protection. $1.

ASA Standards

The following new or revised standards recommendations are available from the American Standards Association, 70 East 45th St., New York 17.

IEC 111, Recommendation for the Resistivity of Commercial Hard-Drawn Aluminum Electrical Conductor Wire. 80 cents.

IEC 113, Classifications and Definitions of Diagrams and Charts Used in Electrotechnology, First Edition. $1.20.

IEC 114, Recommendation for Heat-Treated Aluminum Alloy Busbar Material of the Aluminum-Magnesium-Silicon Type. 80 cents.

C80.1-1959, Rigid Steel Conduit, inc-Coated. 80 cents.

C80.2-1959, Rigid Steel Conduit, nameled. 80 cents.

C80.3-1959, Electrical Metallic Tubng, Zinc-Coated. 80 cents.

C1-1959, National Electrical Code. 1.

C60.6-1959, Measurement of Direct nterelectrode Capacitances. $1.50.

C83.16-1959, Definitions and Terninology for Relays.

IEC 56.4, Alternating Current Ciruit-Breakers. Contains chapters III, V, and V of the International Elecrotechnical Commission's specificaion. Covers strength of insulation, seection of circuit-breakers for service, nd the erection and maintenance of ircuit-breakers in service. $4.80.

IA Publications

The following reports have been ublished by the Electronic Indusries Association, 650 Salmon Tower, 1 W. 42nd St., New York 36.

RS-225, Rigid Coaxial Transmision Lines and Connectors—50 Ohms. rom standards proposal No. 587, it s a revision of TR-134. 8 pages, 80 ents.

Value Engineering—1959. Proceedngs of the EIA Conference on Value ngineering. $6.

RS-228, Fixed, Tantalum Electroytic Capacitors (Polarized). New maerials from S. P. 609. 16 pages. $1.65.

SESA Bulletins

The following bulletins indicate acion taken by the Armed Services lectro-Standards Agency, Fort Monnouth, N.J. Printed copies are not yet vailable.

MIL-STD-701A, Preferred and uidance List of Transistors. Superedes limited coordination standard MIL-STD-701 (Navy).

MIL-C-20C, Capacitors, Fixed, Ceamic Dielectric (Temperature Comensating). Revises MIL-C-20B and ists new detail specifications MIL-C20/1 through /19.

MIL-J-641B, Jacks, Telephone. Suersedes MIL-J-641A and Amendment-2.

MIL-R-14293A, Amendment-2, Reistors, Fixed, High Megohm (Hernetically Sealed).

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Association News

Copper Products Development Association Is Formed

Six major copper producers have formed Copper Products Development Association Inc. to conduct research and studies "for expansion of uses of copper and copper products, and the development of new and improved copper products."

The charter members are: American Metal Climax Inc.; American Smelting & Refining Co.; The Anaconda Co.; The International Nickel Co. of Canada Ltd.; Kennecott Copper Corp.; and Phelps Dodge Corp. Any producer of copper is eligible for membership.

The new organization does not presently intend to provide its own facilities for investigations, but will allocate research assignments to individuals, universities, and established research organizations.

Officers Selected for New NEMA Insulating Materials Division

The Insulating Materials Division, the first of eight industry groups to be organized within the National Electrical Manufacturers Association's new reorganization plan, has selected E. R. Perry, National Vulcanized Fibre Co., to be chairman of the division's board. Under the new plan he automatically becomes a vice president of NEMA and a member of the association's officers committee.

D. J. O'Conor Jr., Formica Corp., was elected first vice chairman of the division, and R. L. Westbee, Irvington Div., Minnesota Mining and Manufacturing Co. was named second vice chairman.

Perry also heads the division's planning committee, which will develop an industry-wide program and draft recommendations for the initiation of division projects. The committee's report will be presented at the division's first convention next June at the Homestead, Hot Springs, Va.

The Board of Directors consists of the heads of each of the sections of the division which are composed of manufacturers of electrical glass insulation, laminated products, manufactured electrical mica, varnished fabric and paper, varnished tubing and saturated sleeving, and vulcanized fibre.

E. R. Perry

Members of the newly organized Board of Directors of the Insulating Materials Division, NEMA, are (left to right): E. H. DaCosta, Taylor Fibre Co.; R. J. Gavin, Irvington Div., Minnesota Mining and Manufacturing Co.; E. M. Markel, L. Frank Markel & Sons; W. K. Lydic, Electrical and Industrial Textile Sales Div., Owens-Corning Fiberglas Corp.; W. H. Bentley Jr., Bentley-Harris Manufacturing Co.; S. M. Hunn, NEMA; R. W. Jorgensen, Plastics Div., The Richardson Co.; D. J. O'Conor Jr., Formica Corp., and Joseph F. Miller, NEMA.

WESCON Paper Deadline Is May 1

Authors wishing to present pape at the technical sessions of the 196 Western Electronic Show and Conve tion to be held August 23-26 shoul submit their papers by May 1. A stracts of 100-200 words, plus detaile texts or detailed summaries, shoul be sent to the chairman of the tec nical program, Richard G. Leitne WESCON Business Office, 1435 Sout La Cienega Blvd., Los Angeles 3

SPE Appoints Forger New Administrative Assistant

Robert D. Forger has been a pointed administrative assistant on t national staff of the Society of Plasti Engineers. His primary responsibili will be the implementation of the ciety's recently expanded public rel tions program.

ASTM Committee Week In Chicago, Feb. 1-5

About 30 of the American Socie of Testing Materials' main technic committees will hold roughly 35 meetings of subcommittees and wor ing groups at the Hotel Sherma Chicago, during Committee Wee February 1-5. Approximately 1500 2000 members and visitors are e pected to attend.

Narrow Fabrics Institute Re-elects All Officers

All officers of the Narrow Fabri Institute have been re-elected f 1960. They are: Board Chairman— Carlton H. Stauffer, York Narro Fabrics Co.; President--John DeAngeles, Murdock Webbing Co Treasurer — Thomas R. Beeche Globe Woven Belting Co.; and Secr tary—A. A. Kuhn, Fiber Manufa turing Co.

SPI Forms Prepreg Committee

A Prepreg Committee has bee formed in the Reinforced Plastics D vision of the Society of the Plasti Industry Inc. It will be concerned wi standardization, particularly in r spect to test methods and nomencl

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ture. The new committee is composed of representatives of companies producing reinforced plastics materials which have been preimpregnated.

New IPC Members

Five companies have recently joined the Institute of Printed Circuits. A new manufacturing member is Fabri-Tek Circuits Inc., and four new associate members are Becco Chemical Div., Food Machinery & Chemical Corp.; Burndy Corp.; Continental-Diamond Fibre Corp.; and Revere Copper & Brass Inc. The next meeting of the IPC will be held in New York, March 22-23, for members only.

English Electrical Exhibition April 5-9

The Electrical Engineers Exhibition will be held in Earls Court, London, April 5-9. About 450 manufacturers of electrical equipment will display their products on nearly five miles of stand frontages. For further information contact Electrical Engineers A.S.E.E. Exhibition Ltd., Museum House, Museum St., London.

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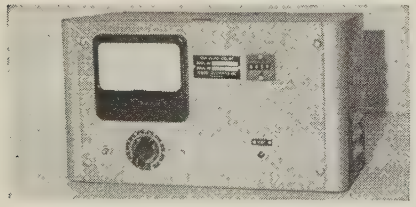

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W.C.L.

Study Tests for Measuring Resistance of Laminates

An insulation research project will be carried on at the University of Delaware in an attempt to develop a reproducible test method for measuring insulation resistance of high-pressure laminates used for electrical circuits or for printed circuitry in aircraft, missile, and electronic applications. The study is jointly sponsored by the Electronic Industries Association, the American Society for Testing Materials, and the National Electrical Manufacturers Association.

New NEMA Officers and Reorganization Plans

New officers of the National Electrical Manufacturers Association are: president, N. J. MacDonald, The Thomas & Betts Co.; vice president, W. C. Wichman, General Electric Co.; and treasurer, A. D. R. Fraser, Rome Cable Corp.

New members elected to the NEMA Board of Governors include: D. E. Allen, Anaconda Wire and Cable Co.; John Brown Cook, Reliable Electric Co.; F. E. Helm, The Reliance Electric & Engineering Co.; Niels C. Miller, Miller Electric Manufacturing Co. Inc.; and P. J. Sullivan, Arrow-Hart & Hegemann Electric Co.

Incumbents re-elected to the board are C. W. Higbee, Kaiser Aluminum & Chemical Corp.; F. F. Look, Allen-Bradley Co.; H. C. McElhone, The Lamb Electric Co.; J. W. McMullen, Allis-Chalmers Manufacturing Co.; J. J. Mullen Jr.; Moloney Electric Co.; D. J. O'Conor Jr., Formica Corp.; J. L. Singleton, Allis-Chalmers Manufacturing Co.; and Chris J. Witting, Westinghouse Electric Corp.

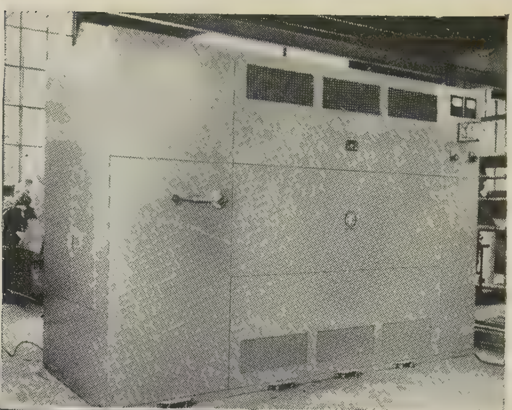
A reorganization plan has also been approved by NEMA. It calls for the grouping of NEMA product sections into eight semi-autonomous divisions, broadening the product scope pattern, and expanding the membership base. One of the new divisions is concerned with insulating materials and another with wire and cable.

Among the many new section officers are: *Capacitors*—Chairman, N. K. Delaney, McGraw-Edison Co.; *Electrical Indicating Instruments*—Chairman, J. R. Whiteside, Simpson Electric Co., and Vice Chairman, W. R. Triplett, The Triplett Electrical Instrument Co.; *Electrical Measuring Equipment*—Chairman, J. J. Doyle, Murray Manufacturing Corp.; *High Voltage Insulators*—Chairman, H. E. Shoemaker, Transmission Distribution Div., Ohio Brass Co., and Vice Chairman, L. J. Dykstra, The Porcelain Insulator Corp.; *Industrial Controls*—Chairman, J. M. Cook, Cutler-Hammer Inc., and Vice Chairman, T. C. Finnell, Motor and Control Div., Westinghouse Electric Corp.; *Laminated Products*—Robert W. Jorgensen, The Richardson Co., and Vice Chairman, H. C. Smith, Micarta Div., Westinghouse Electric Corp.; *Manufactured Electrical Mica*—Chairman, F. M. Grauer, Continental-Diamond Fibre Corp., and Vice Chairman, T. C. Ohart, Insulating Materials Dept., General Electric Co.; *Motors and Generators*—Chairman, R. G. Liebman, U. S. Electrical Motors Inc., and Vice Chairman, P. W. Arnold, The Reliance Electric & Engineering Co.; *Specialty Transformers*—Chairman, L. B. Lattin, Hevi-Duty Electric Co., and Vice Chairman, J. W. Durkin, Transformer Div., Westinghouse Electric Corp.; *Switchgear*—Chairman, Landon Fuller, Westinghouse Electric Corp.; *Transformers*—Chairman, L. Wetherill, Power Transformer Dept., General Electric Co., First Vice Chairman, A. C. Allen, Wagner Electric Corp., and Second Vice Chairman, J. R. Mann, Allis-Chalmers Manufacturing Co.; *Varnished Fabric and Papers*—Chairman, Roy Gavin, Minnesota Mining and Manufacturing Co., and Vice Chairman, E. O. Hausmann, Continental-Diamond Fibre Corp.; *Vulcanized Fibre*—Chairman, Edward H. DaCosta, Taylor Fibre Co., and Vice Chairman, M. R. Stokes, Brandywine Fibre Products Co.; *Wire and Cables* — Chairman, David E. Allen, Anaconda Wire & Cable Co., and Vice Chairman, Vernon W. Heimberger, American Steel & Wire, U. S. Steel Corp., and H. W. Clough, Belden Manufacturing Co.; *Wiring Device* —Chairman, G. R. Weppler, Harvey Hubbell Inc., and Vice Chairman, Le T. Bordner, Sierra Electric Corp.

MARCUS

MARCUS *drytype* TRANSFORMERS

are insulated with NATVAR SPECIAL INSULATION



This trim, compact cabinet houses a Marcus 2000 kva., 4800-480 volt, 3 phase, 60 cycle, dry-type transformer which will supply intermediate AC power to a bank of selenium rectifiers in a large West Coast metal reduction plant.

This interior view shows the rugged construction of Marcus industrial unit substations. A Natvar special combination of Quinorgo® firmly bonded to varnished open-weave Fiberglas provides a flexible insulation of high dielectric strength and great mechanical toughness, plus the ability to withstand continuously high operating temperatures. It is used as a layer insulation for the major insulation barrier between primary and secondary, and between core and coils.

Marcus Transformer Co., Inc., Hillside, N. J. manufactures dry-type transformers from 1 to 3000 kva. capacity, engineered for long life and continuous, trouble-free service.

All materials used in their construction are carefully chosen for durability and performance under maximum loads at high temperatures. A Natvar special combination of Quinorgo® and Fiberglas firmly bonded together is used because of its exceptionally good electrical properties, flexibility, mechanical strength, and its ability to withstand heat.

Whether your requirements call for a standard insulating material, available either from your wholesaler's stock or direct from our own, or a special combination, it will pay you to investigate Natvar flexible insulations.

Natvar

Natvar Products

- Varnished cambric—sheet and tape
- Varnished canvas and duck—sheet and tape
- Varnished silk and special rayon—sheet and tape
- Varnished papers—rope and kraft—sheet and tape
- Varnished, silicone varnished and silicone rubber coated Fiberglas*—sheet and tape
- Slot cell combinations, Aboglas®
- Isoglas® sheet and tape
- Isolastane® sheet, tape, tubing and sleeving
- Vinyl coated and silicone rubber coated Fiberglas tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape
- Extruded identification markers

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We will be very happy to supply information on any of our products on request.

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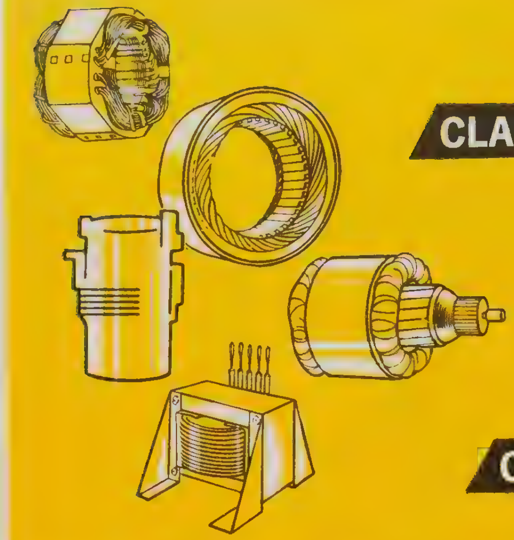

Where can these 5 top performers help YOU improve results . . . *cut costs?*

CLASS H 180°C.

MODIFIED-SILICONE VARNISH V61 V 25
(formerly V61 V C51)
- High heat resistance PLUS high chemical and moisture resistance — meets most Class H requirements
- Air dry or bake
- High build for secure bonding

CLASS F 155°C.

AJAX INSULATING VARNISH V61 V 30
(solvent type)
- Exceeds Class F requirements — withstands intermittent 180°-200°C. temperatures
- Retains high bond strength
- Gives high moisture and chemical protection

AJAX INSULATING VARNISH V61 V 29
(emulsion type)
- Nonflammable — uses WATER as thinner
- Deep penetration — high build
- Excellent resistance to oils, solvents, chemicals, moisture

CLASS B 130°C.

CLEAR, SYNTHETIC THERMOSETTING VARNISH V61 V 24
(formerly V61 V C72)
- Heavy-duty, low cost — meets appliance motor needs
- Outstanding bonding strength
- Fast baking — high build

AJAX EMULSION THERMOSETTING VARNISH V61 V 28
(formerly V61 V C69)
- Saves solvent costs — thins with water
- Deeper penetration — higher build — than solvent materials
- Excellent resistance to oils, solvents, chemicals, moisture

Are new, compact, equipment designs creating new thermal problems for your insulating varnishes? Do you know the benefits that emulsion-type varnishes offer in higher build and bond strength? Are you getting all the advantages of recent improvements in insulating-varnish performance?

You'll find new and better solutions to many insulating problems in the complete line of Sherwin-Williams Insulating Materials. They provide a full range of choice in thermal rating, in physical and electrical properties, in types of solvents and in curing schedules. Ask for technical data on the representative varnishes listed here, or others to meet your specific needs. The Sherwin-Williams Co., General Industrial Division, Cleveland 1, Ohio. In Canada: 2875 Centre St., Montreal.

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☐ Class F Varnish V61 V 30
☐ Class F Varnish V61 V 29
☐ Class B Varnish V61 V 24
☐ Class B Varnish V61 V 28

Name ____________________

Company ____________________

Address ____________________

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Dates to Circle

Meeting and Convention Notices

Jan. 31-Feb. 5 . . . AIEE, Winter General Meeting, Hotel Statler, New York City.

Feb. 1-5 . . . ASTM, Committee Week, Hotel Sherman, Chicago.

Feb. 2-4 . . . SPI, Fifteenth Reinforced Plastics Division Conference, Edgewater Beach Hotel, Chicago.

Feb. 3-5 . . . IRE, Winter Convention on Military Electronics, Biltmore Hotel, Los Angeles.

Feb. 7-13 . . . National Electrical Week, sponsored by National Electrical Week Committee, 290 Madison Ave., New York 17.

Feb. 11-12 . . . Transistor and Solid State Circuit Conference, sponsored by AIEE, IRE, and the University of Pennsylvania, University of Pennsylvania Campus, Philadelphia, Pa.

Mar. 21-23 . . . First National Electric House Heating Exposition, Electric House Heating Equipment Section, NEMA, Sherman Hotel, Chicago.

Mar. 21-24 . . . IRE, National Convention, Coliseum and Waldorf-Astoria Hotel, New York City.

Mar. 23-26 . . . Electrical Maintenance Engineers Assn. of Southern California, Electrical Industry Show and Lighting Exposition, Shrine Exposition Hall, Los Angeles.

Apr. 3-8 . . . Nuclear Congress, Engineers Joint Congress, sponsored by AIEE, IRE, and ACM. New York, N. Y.

Apr. 4-6 . . . AIEE, Southwest District Meeting, Shamrock Hilton Hotel, Houston, Texas.

Apr. 5-9 . . . Ninth Electrical Engineers Exhibition, Assn. of Supervising Electrical Engineers, Earls Court, London.

Apr. 6-8 . . . Institute of Environmental Sciences, National Meeting and Exhibit, Biltmore Hotel, Los Angeles.

Apr. 8-9 . . . SPI, 17th Western Section Conference, New Riviera Hotel, Palm Springs, Calif.

Apr. 11-13 . . . AIEE, Electrical Engineering in Space Technology Conference, Hotel Baker, Dallas, Texas.

Apr. 12-14 . . . AIEE, East Central District Meeting, Daniel Boone Hotel, Charleston, W. Va.

Apr. 20-22 . . . Twelfth Annual Southwestern Conference and Electronics Show, sponsored by Houston Section, IRE, Shamrock Hilton Hotel, Houston, Texas.

Apr. 25-26 . . . SPI, 18th Annual Canadian Section Conference, London Hotel, London, Ont., Canada.

Apr. 25-29 . . . American Welding Society, Annual Meeting and Welding Show, Biltmore Hotel and Great Western Exhibit Center, Los Angeles.

Apr. 27-29 . . . AIEE, Great Lakes District Meeting, Pfister Hotel, Milwaukee, Wis.

May 1-5 . . . National Assn. of Electrical Distributors, 52nd Annual Convention, Dallas.

May 1-5 . . . Electrochemical Society, Technical Meeting, La Salle Hotel, Chicago.

May 2-4 . . . IRE, National Aeronautical Electronics Conference, Dayton, Ohio.

May 2-6 . . . IRE, Western Joint Computer Conference, San Francisco, Cal.

May 4-7 . . . NISA, Annual Convention, Hotel Fontainebleau, Miami Beach, Fla.

May 7-13 . . . SPI, Annual Conference, S. S. Queen of Bermuda (business sessions held at sea during New York City-Bermuda cruise).

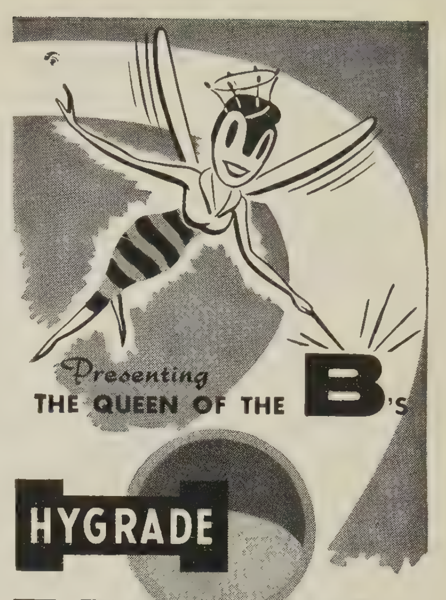
May 10-12 . . . IRE, Electronic Components Conference, Washington, D. C.

May 16-18 . . . IRE, 7th Retec and Trade Show, Olympic Hotel, Seattle, Wash.

June 10-26 . . . British Exhibition of Industry, Technology, Science, and Culture, sponsored by the Federation of British Industries, Coliseum, New York City.

Abbreviations Used in Notices

AIEE	—American Institute of Electrical Engineers
ASTM	—American Society for Testing Materials
ASME	—American Society of Mechanical Engineers
ASA	—American Standards Assn.
IRE	—Institute of Radio Engineers
EIA	—Electronic Industries Assn.
NEMA	—National Electrical Manufacturers Assn.
NISA	—National Industrial Service Assn.
SPE	—Society of Plastics Engineers
SPI	—Society of the Plastics Industry
WCEMA	—West Coast Electronic Manufacturers Assn.



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—a superior Class B insulating tubing of Polyester Varnished Fiberglass . . . better for every Class B application:

Better Compatibility
with the new high temperature wire enamels, glass served magnet wire, and polyester resins.

Better Heat Stability
than other Class B tubings. Excellent electricals both before and after heat aging at 150°C.

Better Flexibility
than other varnished tubings—the result of Markel-developed formulations and processes.

Better Resistance
to acids, alkalies, moisture, and deteriorating effects of hot or cold transformer oil.

A sample of POLYTUBE, with complete data, will be sent upon request.

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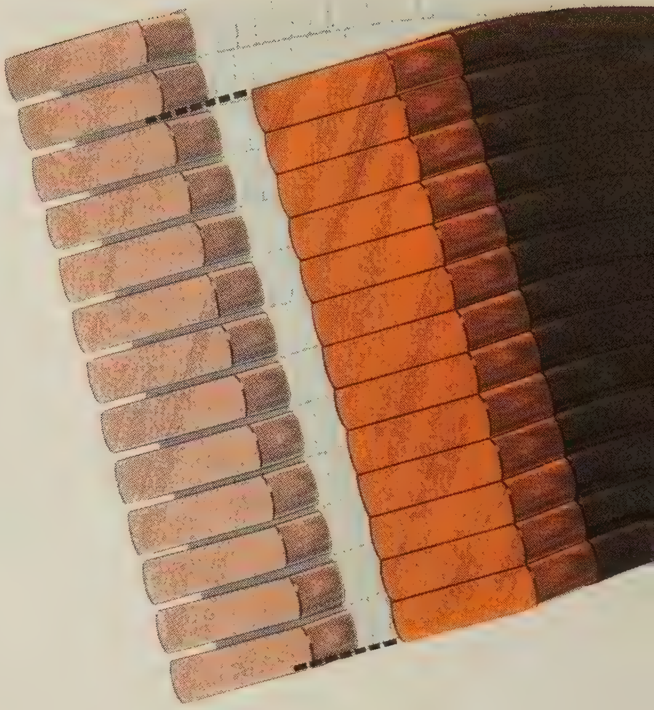
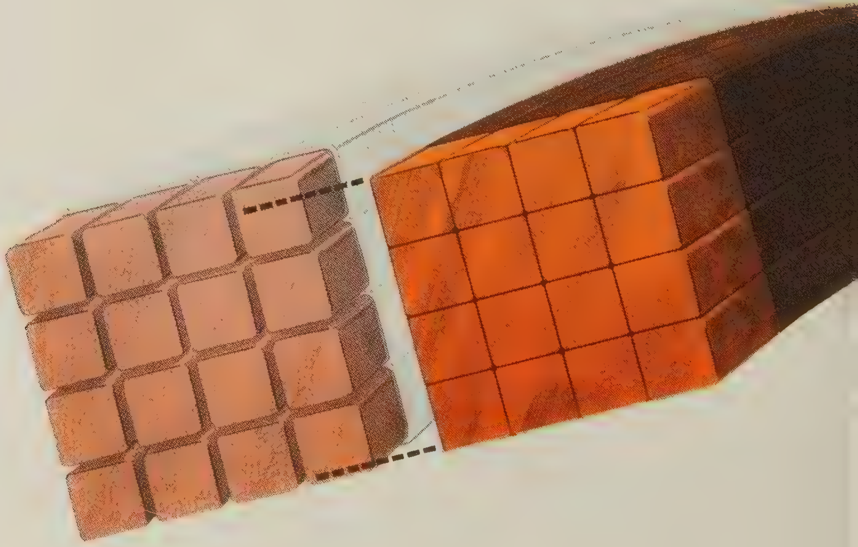


**Consider the
more compact
windings
possible with**

Phelps Dodge Square & Rectangular Film Wires

*that can improve insulation system designs,
cut equipment size and overall costs!*



✓ THERMALEZE® F (155° C)

The Class F film-insulated wire with the best all-around balance of properties. Thermaleze® F can greatly increase the thermal life of equipment with no increase in cost.

✓ FORMVAR

Proved for Class A (105° C) use in many types of distribution transformers, motors and other electrical equipment.

When used under Daglas®, acting as a positive inorganic spacer, Thermaleze® F and Formvar give outstanding performances at Class H (180° C) and Class B (130° C) respectively.

Phelps Dodge square and rectangular film wires also have these accepted advantages:

- Flexibility, toughness and good forming qualities for assembly.
- Better space factor (more turns in less space) that permits (a) reduction in equipment size and cost, or (b) increased power with same size equipment, when used in proper insulation systems.
- High dielectric, moisture-resistant films.

Any time magnet wire is your problem, consult Phelps Dodge for the quickest, surest answer!

FIRST FOR
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Dielectric Strength
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PRESSBOARD INSULATION

Three grades, each combining low cost with the higher dielectric strength a design engineer wants in insulation.

Made of 100% virgin kraft pulp *from our own pulp mill.* This assures uniform quality, no metallic particles.

PRESSITE: An absorbent, unsized board for air, oil, and askarel transformers and for capacitors. Natural kraft color. .031″ to .250″.

ELECTRITE: A hard board with high tensile strength. All punchings are clean and smooth. Sized with natural rosin to resist moisture. Available in brown or black. .031″ to .187″.

DENSITE: An extremely hard board with great tensile strength. Sized for moisture resistance or unsized for applications in oil. Natural kraft color. .031″ to .125″.

Ask for Underwriters Laboratories report #E3987. Write Board Products Sales, West Virginia Pulp and Paper Company, 230 Park Avenue, New York 17, New York.

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Industry News

Librascope Inc., Glendale, Cal. electronic computer, component, and control manufacturer, has established an Applied Research Dept. to investigate new concepts in solid state physics.

A new environmental testing facility in Orlando, Fla., is planned by *Associated Testing Laboratories Inc.*, Caldwell, N. J.

International Radiant Corp., Westbury, N. Y., environmental test equipment manufacturer, is moving to new quarters in New York City.

Brubaker Electronics Div., Culver City, Cal., and Nuclear Instruments Div., North Hollywood, Cal., of *Telecomputing Corp.*, Los Angeles, have been merged to form one new division, *Electronic Systems Div.* The division will be located in North Hollywood. Telecomputing also has purchased *Monrovia Aviation Corp.*, Monrovia, Cal. manufacturer of aircraft sub-assemblies and ground support equipment.

Triad Transformer Corp., Div. of Litton Industries, Venice, Cal., is constructing a 6,000 sq. ft. addition for Triad's Epoxy Molding and Research Depts.

U. S. Transistor Corp. has moved into its new 10,000 sq. ft. plant in Syosset, L. I., N. Y.

Heinemann Electric Co. Inc., Trenton, N. J., circuit breaker and relay manufacturer, has announced plans for a new 100,000 sq. ft. plant to be built in Lawrence Township, N. J.

The explosives and chemicals sales offices of *Atlas Powder Co.*, San Francisco, have been moved to new quarters in San Mateo, Cal.

Continental-Diamond Fibre Corp., Newark, Del., recently dedicated an 18,000 sq. ft. research center for research and development work in laminated plastics, vulcanized fibre, built-up mica, and electrical insulation.

A proposal to merge *Consolidated Electrodynamics Corp.*, Pasadena, Cal. electronic and instrumentation manufacturer, and *Bell & Howell Co.*, Chicago photographic equipment producer, has been approved in principle by the directors of both companies.

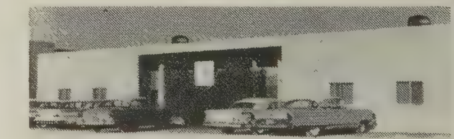
An addition to *Hysol Corporation*, Olean, N. Y. epoxy insulation producer, has been started. When completed, existing office space will be doubled.

A new association, *The Micarta Fabricators' Association*, has been formed by *Westinghouse Electric Corp.'s Micarta Div.*, Hampton, S. C., and by 17 major fabricators of industrial parts.

A 20,000 sq. ft. building was dedicated recently in Ambler, Pa., by *Keasbey & Mattison Co.*, asbestos producer. The building will house the company's headquarters and research and development center.

Northern Plastics Corp., LaCrosse, Wis., has reported sales for the 1959 fiscal year of $4,302,161 compared with the previous year's $2,747,893. Earnings were $321,192 compared with $123,783 for the preceding fiscal year. Northern has also appointed three sales representatives, they are: *General Aeronautics*, Derby, Kans.; *James Spindle*, Granada Hills, Cal., and *Stanley Weeks*, San Mateo, Cal.

An 11,000 sq. ft. facility has been opened by *Avnet Electronics Corp.* in Sunnyvale, Cal., for assembling electrical connectors.



A new 20,000 sq. ft. building, located on the *Crane Packing Co.'s* present site in Morton Grove, Ill., will be devoted exclusively to the processing of "Teflon."

HYSOL

OFFERS
A COMPLETE
LINE OF
SUPERIOR QUALITY
EPOXIES . . .

ADHESIVES & SEALANTS

ELECTRICAL INSULATING COMPOUNDS FOR . . .
- CASTING
- ENCAPSULATING
- IMBEDDING
- IMPREGNATING

MOLDING MATERIALS

TOOLING MATERIALS

EPOXI-PATCH KITS

CAST ROD, SHEET & TUBE

CUSTOM FORMULATIONS AND PACKAGING

HYSOL CORPORATION
formerly Houghton Laboratories, Inc.

Nothing has changed but the name . . .

Acceptance of our brand name HYSOL has been so universal that we are changing our name from Houghton Laboratories, Inc. to HYSOL Corporation.

As America's first manufacturer of the highest quality epoxy resin electrical insulating materials, adhesives, tooling materials and cast products, we believe HYSOL Corporation more accurately reflects the full scope of our products and services.

Nothing is changed but the name. Our company policy remains unchanged. We renew our pledge to a continuing program of research, responsibility and results which can only mean progress in the field of epoxy compounds.

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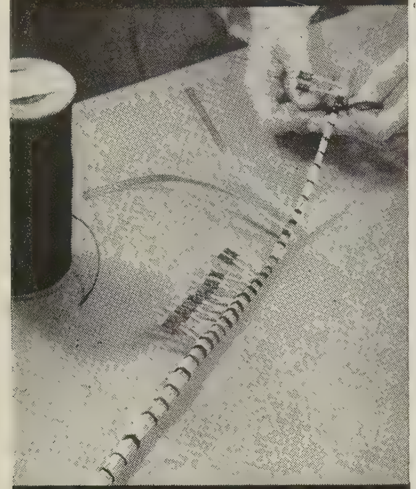
A HIGH-HEAT
NON-SLIP
LACING TAPE



GUDEBROD'S
TEMP-LACE H

Gudebrod synthetic rubber finish has now tamed slippery Teflon* by coating it with synthetic rubber. Once cables are laced with Temp-Lace H, they're laced for good . . . because there's no knot-slip; no harness slip. Assemblies stay tight and firm.

Flat-braided of pure, inert Teflon, Temp-Lace H is noncorrosive to hands or instruments. Now coated with Gudebrod's non-flaking, fungistatic rubber finish, it's non-slip, and flexible from −40° to 220°C. It won't cut through insulation.

Temp-Lace H is available in five sizes; or we will engineer a tape to meet your specifications. Write today for Data Book giving complete information on ALL Gudebrod Lacing Tapes and Drive Cords.

*DuPont's TFE fluorocarbon fiber
Temp-Lace H—Pat. Pending.

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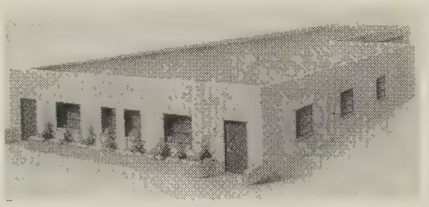
Electronic Research Associates Inc., Cedar Grove, N. J., has acquired *Advanced Acoustics Corp.*, Nutley, N. J. high frequency reproducer manufacturer. Advanced will operate as a wholly owned subsidiary of ERA.

Webster Electronics Co. Inc., Brooklyn components producer, has been acquired by *John Chatillon & Sons Inc.*, New York City.

A new electrical insulation firm, *Salem Plastics Inc.*, Salem, Ohio, has been formed.

Anachrome Corp., South Gate, Cal., has established the Arizona Div. in Tucson for the production of hard anodized coated parts.



An 8,000 sq. ft. building has been placed in full operation in Fort Myers, Fla., by *Texas Crystals Div.*, *Westronix Inc.*, processor and supplier of crystals for the electronics industry.

Milro Controls Co. has completed a move to expanded facilities in Saddle Brook, N. J. The firm manufactures electronic controls.

Lance Antenna Corp., San Fernando, Cal. has acquired the antenna and mast lines of *Gonset Div.* of *Young Spring and Wire.*

Davis-Standard Div., *Franklin Research Corp.*, Mystic, Conn. plastic extruder manufacturer, has added Michigan to the sales territory of *C. J. Beringer Co.*, Chicago.

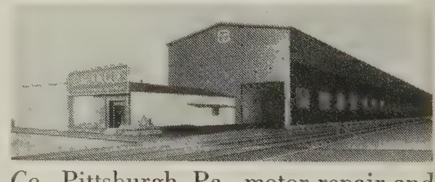
International Sales Corp., Seattle, is now handling the insulation compound line of *Marblette Corp.*, Long Island City, N. Y.

Hercules Powder Co., Wilmington, Del., has announced plans for a multimillion dollar expansion of its west coast facilities at Hercules, Cal. Production of 8-million gallons of methanol, 50-million pounds of formaldehyde, and 11,000 tons of ureaformaldehyde compositions is expected.

Glastic Corp., Cleveland fiber glass reinforced plastic producer, has just completed installation of a press for flat sheet molding.

An expansion program for *Eleonora Div.*, *The Pantasote Co.*, Passaic, N.J., is expected to increase the firm's polyvinyl chloride resin capacity by 300%.

A 30,000 sq. ft. second plant has been acquired by *Motor Coils Mfg. Co.*, Pittsburgh, Pa., motor repair and motor coil manufacturing firm.



Kiva Sales Co., Phoenix, will represent *Mid-Eastern Electronics Inc.*, Springfield, N. J. test equipment manufacturer, in Arizona.

Sylvania Electronic Tubes, a division of Sylvania Electric Products Inc., plans construction of a multimillion dollar electron tube manufacturing plant in Brookville, Pa., replacing three existing facilities. The new 100,000-sq. ft. installation will be situated on a 20-acre site.

Southwestern Industrial Electronics Co., Houston, has appointed three

ALITE®

CERAMIC-TO-METAL SEALS

Standard Bushings or Special Designs

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ALITE — with its completely equipped facilities for producing high quality, vacuum-tight, ceramic-to-metal seals — is geared to meet all your requirements for high alumina ceramic-metal components. From design to finished assembly, every manufacturing step — including formulating, firing, metalizing and testing—is carefully supervised in our own plant. Result: effective quality control and utmost reliability.

Hermetic seals and bushings made of high alumina Alite are recommended for electromechanical applications where service conditions are extremely severe or critical. Alite has high mechanical strength and thermal shock resistance. It maintains low-loss characteristics through a wide frequency and temperature range. It resists corrosion, abrasion and nuclear radiation. Its extra-smooth, hard, high-fired glaze assures high surface resistivity.

To simplify design problems and speed delivery, Alite high voltage terminals, feed-throughs and cable end seals are available in over 100 standard sizes. However, when specifications call for special units for unusual applications, you can rely on expert assistance from Alite engineers to help you take full advantage of Alite's superior properties.

Write us about your specific requirements today.

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Bulletin A-7R gives useful comparative data. Bulletin A-40 describes Alite facilities and complete line of Alite Standard Bushings.

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more representatives to handle test instrument sales, as follows: *Comptronics*, Seattle; *Pat Lind Electronics Co.*, Circle Pines, Minn.; and *M. P. Odell Co.*, Westlake, Ohio, Pittsburgh, Dayton, and Detroit.

Minnesota Mining & Manufacturing Co., St. Paul, Minn., will build a 10-million dollar, 14-story administration building at its research center just east of St. Paul. Site preparation has begun and the building is expected to be completed early in 1962. It is planned that the research and administrative center will expand from today's seven buildings to a "campus" of some 30 buildings.

Schenectady Varnish Co. Inc., Schenectady, N.Y., has appointed *John H. Cole Co.*, Oklahoma City, Okla., as a distributor for its electrical insulating varnishes.

Insulation and Wires Inc., St. Paul, Minn., has been appointed a distributor for the laminated silicone glass cloth wedges made by *Silicone Insulation Inc.*

A new firm, *Dynatran Electronics Corp.*, has been organized in Mineola, N.Y., to manufacture industrial test equipment.

Commercial Plastics & Supply Corp., New York City, has opened a new sales and service office and warehouse in Atlanta, Ga. John Gillette is manager of the operation.

Shaw Instrument Corp. has acquired by merger *Ceramic-Metal Assemblies Corp.* Both firms are located in Latrobe, Pa. Products include pyrometers, electronic instruments, metallized ceramics, and vacuum type seals.

Furane Plastics Inc., Los Angeles epoxy resin producer, has opened a plant in Hempstead, L.I., N.Y. Leon Wynn as eastern sales manager will be in charge of the operation. *Samuel A. Jeffries Inc.* has been appointed sales representative in Pennsylvania, Maryland, and Washington, D.C.

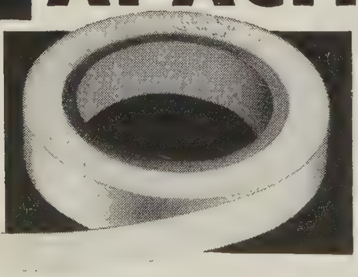
Formica Corp., Cincinnati laminated plastics producer, has established a nationwide sales force to handle its industrial products.

Cortland Industries Inc., Chicago distributor and fabricator of plastics, fiber, and paper, has expanded its facilities through the purchase of a 60,000-sq. ft. building to replace one of its present plants.

R. S. Hughes Co. Inc. has completed construction of a new warehouse in Denver for stocking "Teflon," nylon, "Kel-F," and epoxy resins and plastics as well as sleevings, coated fabrics, tape, laminated plastics, and wire.

Accurate Specialties Co. Inc. has formed a controlled subsidiary called *Metalizing Industries Inc.* in Hackensack, N.J., for the production of metalized ceramic electronic components.

Associated Testing Laboratories Inc., manufacturer of environmental test equipment, has appointed *ARCO Engineering Co.* of Washington, D.C., as its representative to the U.S. Government.



CHEMO
has:
"TAPACITY"

"TAPACITY" . . . the capacity to produce the insulation tape you want when you want it . . . that's Chemo's reputation right across industry!

Chemo Tapes of TEFLON* are finding their way into more miles of dependable use daily.

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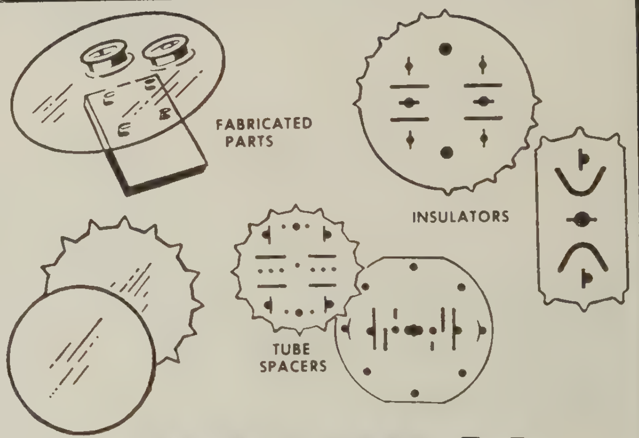

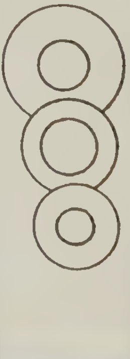

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Increasing Motor Capacity With High Temperature Insulation

y R. L. Nailen, Motor Engineering Section, Westinghouse Electric Corp., Sunnyvale, Cal.

Industrial production rates con- nue to spiral upward, outdistancing ols and processes once thought nple. And an increasingly competi- ve market requires that costs be kept own. "Uprating" and "rerating" of ectric motors are therefore becoming idespread, and questions arise con- erning the insulation systems that elp make such changes possible. hat are these "high temperature" sulations? How should they be ap- ied? What do they cost? What are eir limitations? This article will tempt to answer these questions.

Let's start with some basic termi- ology. An insulation "system" is the tire group of insulation components a motor (or other electrical appa- tus) which keeps the conductors in ace and separated from each other s well as from "ground" (the motor ame). The system consists of wire overing, slot liners, wedges, phase sulation, and varnish—a wide vari- y of sheet, tape, and molded mate- als. Each such component is "rated" terms of the operating temperature which it will give satisfactory serv- e life without failure. Originally it as felt that a complete system rated , say, 50°C rise over a 40°C ambi- nt, must contain no component that id not have this same rating. Hence e definition of the most common ass of insulation system, class A, as e containing only organic material paper, cloth, etc.) and good for ormal life at operating temperature ot exceeding 105°C at the hottest ot in the system. What "normal" fe is, and the effect of temperature life, will be mentioned later.

Similarly, class B insulation was efined as using glass, mica, etc., and tended for 130°C hot spot temperature. Next step up is the class H system, built around silicone materials and good for 180°C. Classes B and H are the high-temperature insulations in common use.

In recent years it has been recognized that some of the system components serve a primarily structural or mechanical function. Also, in operation all parts of the system aren't equally heated. So current system definitions do not require that *all* materials in a class B or class H insulation system have equal thermal properties; merely that the system *as a whole* will function at its rated temperature. For example, NEMA Standard MG1-6.08 reads:

*Class B: "Materials or combinations of materials such as mica, glass film, asbestos, etc., with suitable bonding substances. Other materials or combinations of materials, not necessarily inorganic, may be included in the class if, by experience or accepted tests, *they can be shown to be capable of operation at Class B temperatures. (*"Test procedures for the evaluating of insulating materials and insulation systems are under development by the American Institute of Electrical Engineers.")*

So much for what the systems are. The higher temperature classes B and H are useful for two reasons:

1. They allow operation of an existing motor design originally intended to have class A insulation beyond its original thermal capacity.
2. They permit design of motors on frame sizes smaller than the standard class A insulated sizes, which is a valuable space and weight saver.

"Operation beyond original thermal capacity"—this can mean two different things for a motor and it is important to distinguish between them. One such overload condition simply involves more horsepower output than the motor could deliver within class A insulation temperatures. The second condition involves placing of the motor in a location where ambient temperature is much higher than normal. Unless otherwise specified, motors are rated for operation in an ambient not exceeding 40°C. Though good for most applications, this ambient limit may sometimes be exceeded by 2 or 3 times.

The amount of horsepower overload possible through use of high temperature insulation is normally 15-20 percent with class B insulation and 30-35 percent with class H (still higher in some cases). Such extra capacity is made to order for drives which occasionally require "peaks" of 125 percent or more of normal horsepower. When these peaks are infrequent it's impractical to install a class A insulated motor large enough for continuous duty at peak horsepower. Such a motor would run most of the time at unnecessarily low efficiency and power factor. For example, a typical 100 hp motor running 16 hours each working day, 12 of them at only 60 or 70 hp, would needlessly waste 2100 kwhr per year of energy (because of its low efficiency when operated at such low horsepower), besides helping to drive down the plant power factor. For a lower first cost and a considerable space saving, a class H insulated motor of two-thirds size would do the job.

In considering this use of high temperature insulation, remember that such insulation alone won't affect the torque capabilities of a motor. Consider a motor having a breakdown torque of 500 pound-feet, which is rated at 75 hp with class A insulation. If rewound using class H insulation, with no other change, it will still have a breakdown torque of 500 pound-feet and no more—even though its full load rating can be raised to 100 or 125 hp. The same is true of starting torque. The reason is the dependence of torques on the magnetic circuit in the motor. Relative amounts and arrangement of iron and copper in the design are not materially affected by the class of insulation used. A redesigned winding can usually be made to increase available torque capacity, but this is a ticklish job—excessive starting current and poor efficiency and power factor may result. Keep in mind, too, that if the horsepower peaks are sufficiently short or infrequent, special insulation may not be necessary to handle them. The reason lies in the relation between operating temperature and insulation life. Overloading a motor so that the winding temperature exceeds the rating won't cause immediate failure. It will shorten the service life of the insulation, and in many applications this can be tolerated.

The relation between insulation temperature and life is illustrated in figure 1. As an example of what may happen, assume a 40°C rated rise motor (class A insulation) that is run for half an hour out of each 24 hours at 130 percent of rated horsepower. Minimum insulation life will drop to about 5 years of continuous operation instead of 7. Of course, if the 130 percent load were carried all the time, the motor would probably last only 6 months.

This discussion of life is, of course, based on operating life—that is, the amount of motor running time that can be expected. If used in an application where it only is operated 8 hours a day, the motor will last much longer before a rewind is necessary.

How the motor handles these "short-time" overloads is shown in figure 2. This also shows what happens when the motor is uprated by an insulation change—the extra torque capacity to handle peaks is reduced.

What about the cost of high temperature motor insulation? Let's look at it two ways. First, if the motor is a new one: a 75 hp 1800 rpm drip-proof motor, with class A insulation and rated 40°C rise, lists at $1711. The same job may be done by a 50 hp motor, 40°C rise, but with class H insulation, at a $300 saving in list price. (A class B insulated 60 hp motor would also handle the application, with less saving in cost). If, on the other hand, you order the 75 hp motor rated 110°C rise with class H insulation, you will get it on a smaller frame size at no cost saving, but with a considerable reduction in size and weight (see figure 3).

Second, if you are planning to rewind and uprate existing motors, expect to save 50 to 75 percent of the cost of the new motors of the higher ratings.

Some words of caution about these insulations, particularly class H: Don't count on them to solve all motor operating problems. Lack of proper motor protective devices, or their failure to work, can burn out a class H winding, too. Severe duty cycles (plugging, frequent starting, etc.) can still wreck the motor. An instance is on record of a motor which stalled and the cast aluminum squirrel-cage rotor melted and flowed into the windings. The silicone insulated winding didn't fail, but it didn't keep the motor in service either.

Another occasional problem with class H motors is the high operating temperature itself. Frame surface o a TENV silicone motor may get a hot as 140°C. Contact with the frame could cause a bad burn. Operation and maintenance people should b alerted to the danger. Warning signs special paint color, or even guard should be considered for such applications.

This temperature may also be problem in locations where explosive vapors are present. Short-time over

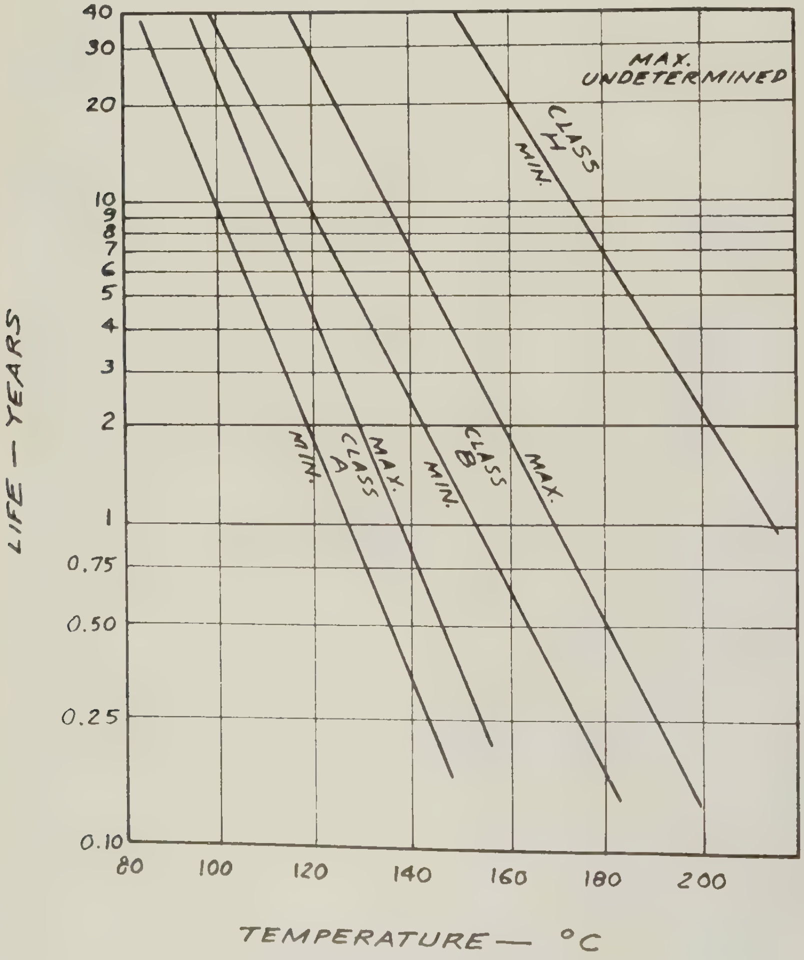

Figure 1, insulation life as a function of temperature.

oad (or obstruction of ventilation) n totally enclosed class H motors can aise frame temperature to the igni- ion point of many flammable vapors. Jsually a built-in motor thermostat s required by underwriters to dis- onnect the motor from the line before his can happen. Such construction nay not be readily available, and hould be negotiated with the motor nanufacturer.

Common usage of high tempera- ure insulations has caused some mis- inderstanding of "rerated" motors. An industry-wide rerate of small notors, conforming to changes in NEMA standards, results in increasing he horsepower output of each physi- al size of motor. This has given some isers the impression that the "re- ated" motor must run hotter than the old design. But in most cases this is iot true. Squeezing more power out of a given size machine is done by using better materials (i.e., insulation hat is thinner but stronger) in better irrangements. Standard a-c motors still have class A insulation, and are still rated 40°C rise drip-proof and 55°C rise totally enclosed—the same emperature ratings that were used before. We may eventually see class B or class H insulation as the standard for future rerate programs, but it isn't rue now.

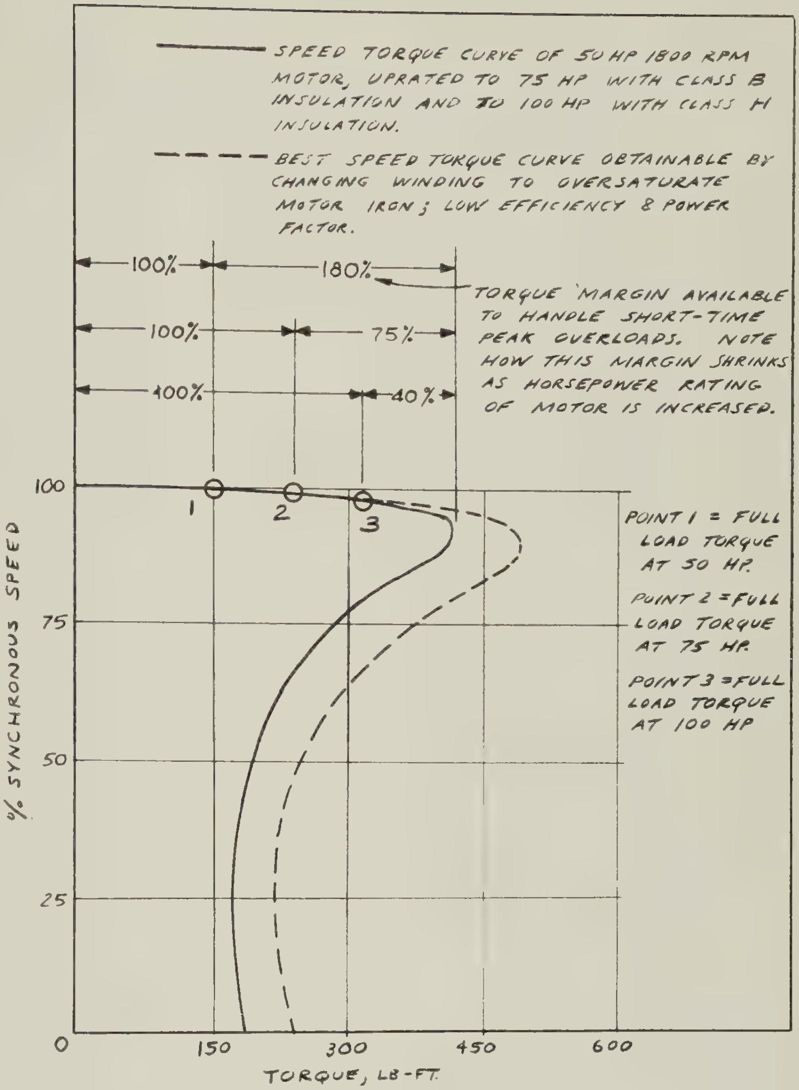

Figure 2, typical motor torque characteristic showing overloading effect.

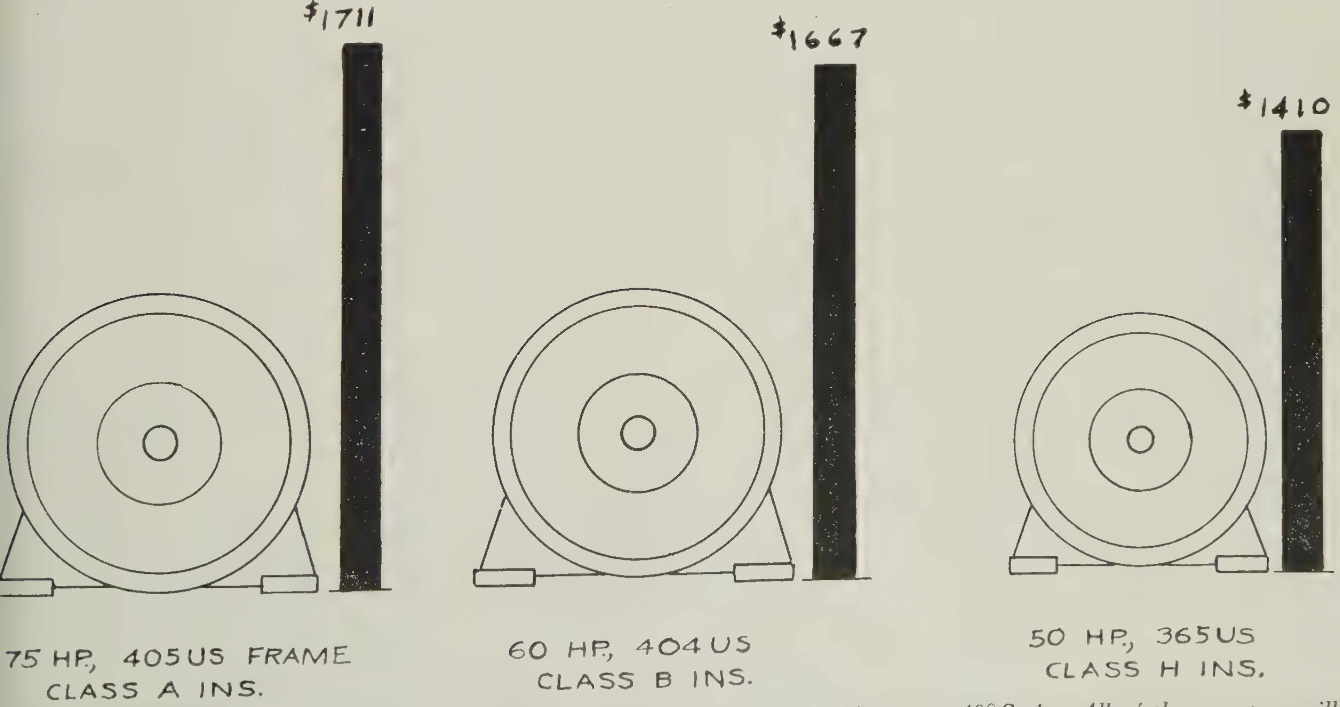

Figure 3, price and size comparison for standard 440 v 1800 rpm drip-proof motors. 40°C rise. All of these motors will safely carry a 75 hp load.

Men in Insulation

Carl L. Christiansen
New York Electrical Industry Sales Manager, Dow Corning Corp.

This feature is devoted to a leader in the insulation field—his work, background, accomplishments, traits, and goals. It is well-deserved recognition of significant contributions made to the industry. It is also hoped that occasional biographical sketches such as this will provide encouragement to other men concerned with insulation.

Since often it is so difficult to ascertain the value, in a broad sense, of a salesman to the industry, this feature has been primarily devoted to men who have made technical contributions. But this month we welcome with special pleasure the opportunity to recognize the efforts of an insulation salesman whose work has already resulted in tangible benefits to the insulation field.

The people of his home town, business associates, and many friends in the insulation field know Carl L. Christiansen, usually affectionately called "Chris," as the man to see whenever a community or industrial project is to be done.

Perhaps this was because he learned responsibility early. His storybook career, which covers work in nearly every phase of the electrical field, began when he was 13 and forced to go to work because of the death of his father. He took night school courses and at 15 became the youngest commercial radio operator on the Atlantic Ocean.

This was during World War I and was the beginning of his interest in electricity. After the war he worked for public utilities, primarily the New York Edison Co., as a switchboard attendant and later as a sub-station operator. His interest in electricity continued, and he attended an off-time electrical school operated by the Edison Co. After several years he became associated with the Public Service Electric & Gas Co. of N. J. as a sub-station operator and later joined the firm's sub-station construction department.

For several years he worked in the electrical construction phase of the industry — then became interested in illumination and took a job with the Post Office Department, U.S. Air Mail Service, as supervisor of airport lighting construction for the first night mail runs between New York City and Cleveland. This entailed the illumination for airports, boundary lighting for approach areas, etc. He did much to further the safety of aircraft by designing and installing safety tilt-over cone boundary lights, disconnect-type plugs and switches, and inexpensive underground cable splices, etc.

When the air mail service was taken over by private contractors, he was appointed the first supervisor of construction and field engineer for the Lighthouse Division, U.S. Dept. of Commerce, which is now the Civil Aeronautics Authority.

He became known as an expert on airport illumination and was soon employed by the airports division of Curtis-Wright Corp. and put in complete charge of the design, purchase, engineering, and installation of all lighting equipment for 14 of the largest airports in the country at that time.

During this period, he developed the first boundary lighting signaling systems for incoming pilots, improved on the tilt-over cone, and assisted in the development of the 180° arc-type flood-lighting and of a shadow bar which continuously kept the flood lights out of the pilot's eyes.

Then, after a short time without a job during the depression, Pan-American Airways asked him to take charge of the electrical installation on island bases for the China Clipper run from Alameda, Cal., to Macao, China. The job included installation of lighting equipment and radio direction finding equipment at Honolulu, Wake Island, Midway Island, and Guam.

Among other problems they encountered was a serious shortage of fresh water which led them to construct stills. When the water shortage became less acute, scientific curiosity led to some experimentation from which it was concluded that prunes, apricots, and raisins, when properly handled, made a fairly palatable alcoholic beverage.

After a year in the South Pacific, he came home and joined the John C. Dolph Co., an insulation varnish manufacturer. By this time his background was so diversified that he was familiar with the use and application of electrical insulation on almost any type of equipment or application. He soon became very popular in the insulation field because of his ability to discuss the use of his materials.

He joined the Dolph organization just when the oxidizing varnishes were being replaced by the synthetic thermo-setting varnishes. Consequently, he became very active in the campaign to get the users of insulating varnishes to increase treating temperatures, reduce baking times, and institute the two-part baking system —that is, first remove the solvent, then cure the solid.

It was at Dolph that he and other associates introduced the dry vacuum, additional vacuum step for vacuum impregnating tightly wound coils of thick cross sections. This procedure is used for this type work today.

While at Dolph he became interested in the National Industrial Service Association and soon was very active. He is well-known for his willingness to promote the group and has written many articles and delivered many speeches for the general welfare of the association. He had a great deal to do with uprating the baking and impregnating facilities in repair shops from coast to coast through his safety campaigns on better oven practices, more efficient oven equipment, and safer impregnating equipment.

He is also a practical "idea man." For instance, he was asked to develop a one-shot, 10 to 15-mil thick film build-up to replace three dips and bakes formerly used at a factory of a large electric motor manufacturer. The material was developed by Dolph, but a new impregnating system also had to be devised for the viscous material. His solution was a six-station vacuum impregnator which enabled three operators to produce six vacuum-impregnated stators at a time.

An individualist with a sense of humor, during his early association with NISA he adopted the habit of wearing a yellow rose as a boutonniere at the annual conventions. He claims there are too many bald-headed men wearing dark blue suits at conventions and it is much easier to find the "bald-headed man with the yellow rose."

On another occasion, he was asked to deliver a speech on electrical insulation in Boston. Having been invited by the chairman of the meeting to make himself comfortable, he took off his new shoes which were bothering him. When it came time for him to address the group, he was much embarrassed because he could not get the shoes back on. So he spoke without them and is known in the New England area as "Shoes Off Christiansen."

About 10 years ago, he began hearing about the new high temperature materials called "silicones." His curiosity aroused, he collected all available information—which at that time was rather sketchy. However, it was enough to make him feel that silicones possessed great potential for improved insulation and definitely were worth the effort needed to introduce them and to make them acceptable to the industry. Accepting the challenge, he joined Dow Corning Corp. as technical sales representative in the electrical section. Throwing himself enthusiastically into the new job, he soon became known nationally as "Silicone Sam."

Many people give him credit for being in large measure responsible for the success of the silicones in his electrical sales area. It is felt that his one-man educational campaign on silicones sliced years off the normally expected introductory period.

In the past 10 years he has been instrumental in the development and marketing of many new materials brought out by Dow Corning and accepted by the industry. He did a tremendous amount of work for the Bureau of Ships in its Navy rewind and repair program, delivered hundreds of lectures, and wrote many articles on the use and application of silicone materials.

He has continued his activity and membership in associations such as NISA, AIEE, Armed Forces Communications and Electronics Assn., and was one of the active originators and supporters of the First National Conference on the Application of Electrical Insulation. In fact, many of the leaders in the insulation industry remember his efforts pointing toward such a conference even while bedded down in a Philadelphia hospital with coronary trouble years ago.

His personal life has been filled with good work for others. In earlier years, if he were called upon to fill in an application for employment, under hobbies he would have written "raising four boys." This particular hobby caused him to be active in boys' groups such as the Cub Scouts, Boy Scouts, Sea Scouts, etc. He was one of the originators of the Booster Club to promote athletics in the small town in which he lived. He now lives in a small cottage-type home in Green Brook, N.J., surrounded by lawns, roses, seven grandchildren, and innumerable friends. The three oldest boys, Carl Jr., George, and Donald, are married, while the youngest, Robert, is a freshman in high school. Carl Jr. is product development laboratory manager, International Business Machines, Poughkeepsie, N.Y.; George is proprietor of the Park Auto Top and Glass Co.; and Donald is credit manager for a Sherwin Williams branch in Claremont, N.H.

One of his most outstanding community service projects was the organizing of the second first-aid and rescue squad in the state of New Jersey, the Dunellen Rescue Squad. Now over 25 years old, it is considered one of the finest and most active squads in the U.S. He is a charter member, and was the first president. He is also a former member of the New Jersey State First Aid Council, and presently is a member of the International Rescue and First Aid Association. He served many years as a Volunteer Fireman in Dunellen, and now is a member of the Dunellen Exempt Firemen's Association.

He is an active member in the Airmail Pioneers Association, which is dedicated to the perpetuation of air transportation pioneering.

An inveterate story teller, he enjoys passing on his experiences and has developed his own 4-H club for salesmen, the four H's standing for "be honest, human, happy and hopeful."

His ambition is to establish a cooperative testing laboratory in the insulation industry that "will take all the hocus-pocus out of data sheets, specifications, etc." The laboratory's seal of approval on materials would assure the buyer or user that they complied with minimum standards. At the same time, such facilities would enable smaller insulation manufacturers to have at their disposal high quality laboratories for proper evaluation of materials.

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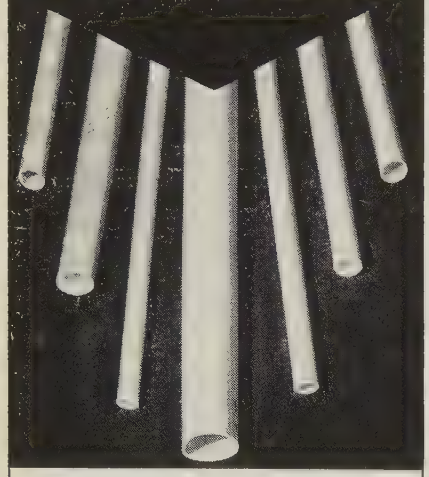

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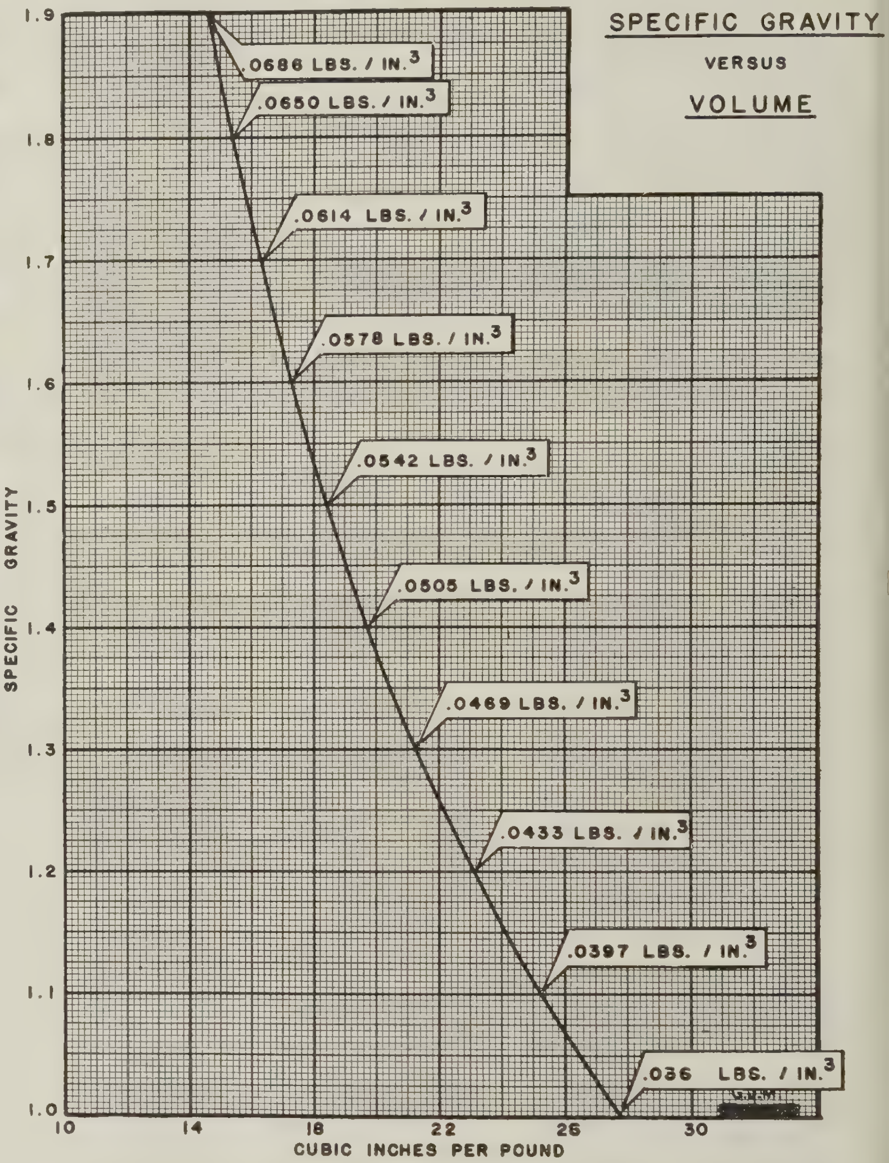
Graph on Specific Gravity vs. Volume

The graph shown below is a handy aid for figuring the specific gravity or the volume of vulcanized fibre and laminated plastic materials. If one of the values is known, it is a simple matter to locate the other. The graph is published exclusively by *Insulation* through the courtesy of Taylor Fibre Co.



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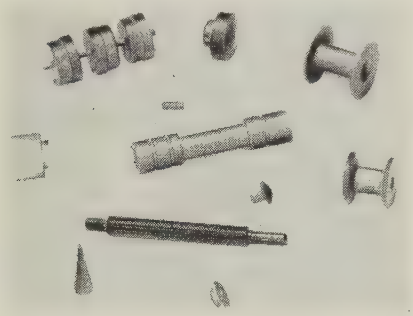
Crush Grinding for Small Parts

When forming small cylindrical parts such as bobbins and reels from laminated plastic or vulcanized fibre, particularly in large quantities or to extremely tight tolerances, crush form grinding may do the job as much as 20 per cent faster than screw machine or lathe production.

It leaves no burrs, thus eliminating a separate operation, and is recommended by Taylor Fibre Co. where finish tolerances must be held to ±.0005 inch or tighter (normal screw machine or lathe tolerance is ±.002 inch), where the parts are required in large enough quantities—generally 300,000 and upwards—to justify initial cost of wheels, and where lathe bits might cause delamination of the laminated plastic.

Crush or plunge grinding is relatively new, having been developed within the past 15 years specifically for forming small parts from nonmetallic materials such as plastic laminates. It utilizes the conventional grinding and backup wheels and work rest.

A multiple series of grooves, bevels, or other configurations are cut into the work wheel surface for the specific part being formed. As many as 25 or 30 small parts can be made at a time from a single piece of feed stock, at rates of up to 5 or 6 cycles per minute. Wheels are capable of long runs with little wear, depending upon the material being worked. When they do wear, they can be redressed.



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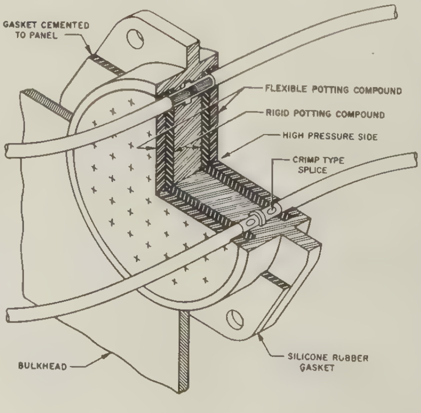
Sealed Wiring Panels In Convair Jetliner

Cutaway view shows the principle of the multiwire sealed panels developed by Burndy Corp. to carry electrical wiring through bulkheads of the Convair 880 jetliner while maintaining cabin pressurization. The circular part of the panel illustrated is 1.826″ in diameter. Wires (as many as 48 per panel) are crimped to silver-plated copper alloy links, with barriers which conduct current but seal against all air leakage, even around wire strands. After wires are drawn through holes in the glass-filled diallyl phthalate panel, they are sealed with "Stycast" flexible compound on the outside to permit flexing of leads. The panel is cemented to a silicone rubber gasket, in turn cemented to the bulkhead. Panels operate at pressures up to one atmosphere and temperatures to 300°F.

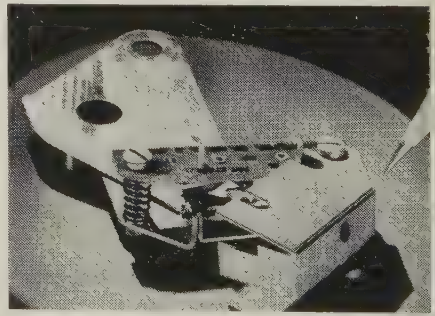


Plastic Electrical Conduit

Approximately 30,000 feet of 5-inch plastic conduit used for underground electrical installations serving three new buildings on the campus of the University of West Virginia at Morgantown reportedly was installed in less than half the time normally required for other types of ducts. The "Dur-X" conduit, produced by Franklin Plastics, Inc., Franklin, Pa., was installed in 30-foot lengths with all joints completely waterproofed by use of a plastic compound. The flexible conduit was assembled on top of the ground and then lowered into the excavation, long radius bends being possible without the use of elbows or deflector couplings.

Inexpensive Switch Guard

An arc spatter guard, die-formed from a new flame-resistant grade of vulcanized fibre, is said to be produced faster and at low unit cost. It is used on a new Underwood Corp. adding machine to enclose an open switch. The fabricated guard is made of "Pyronil," a flame-resistant cellulose plastic material made by National Vulcanized Fibre Co., Wilmington, Del.



New Products

For further information on these roducts, print the item number on he Reader Service Inquiry Card in his issue. Fill out and mail card—o postage required. Insulation *will nmediately forward your inquiry to he manufacturers concerned so that hey can send you more information romptly.*

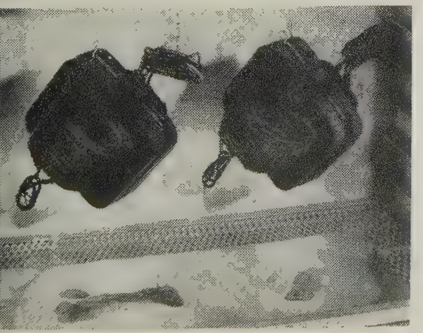
lew Coated Fabric Insulation for 50°C Operation, Radiation Resistance

"Herox" synthetic resin coated fabics, which appear of primary interest s electrical insulation up to and omewhat above class H temperatures nd are unusually resistant to radiaion, reportedly can now be supplied n experimental quantities. Available n single ply as well as laminates, "Herox" coated glass fabric from hree to 10 mils thick is described as aving potential moderate cost. Preiminary tests show these construcions capable of withstanding tempertures up to 250°C for over six nonths. They are essentially unafected by 3,000 megarads of radiaion, or by exposure to fluorinated ydrocarbon refrigerants and most ommon solvents. They are attacked, owever, by dimethyl formamide and limethyl acetamide. They will withtand dilute aqueous acid and alkaine solutions but not concentrated cids and bases. New Products Buletin No. 7-B obtainable. Fabrics Div., Du Pont Co., Attention R. L. Lester, Room 7033-D, Wilmington 98, Del.

rint No. Ins. 101 on Reader Service Card

lew Easier Processing Class H ilicone Varnish Cures at 150°C

Dow Corning 980 varnish, a new lass H silicone dipping and impregnating varnish is said to be as easy to process as most class A and B varnishes. This new material reportedly cures in only six hours at 150°C, 50°C below that required for other silicone varnishes. In addition, runoff is said to be substantially lower than that for other varnishes (see photo—980 on right), indicating savings in equipment maintenance and clean-up time. DC 980 is claimed to meet AIEE requirements for use in 220°C systems, has greater heat stability than any other varnish known, resists moisture, and is unaffected by many corrosive atmospheres. When used with other class H components in power transformers, servomechanisms, and electronic devices designed for higher temperature rise, the greater thermal stability of DC 980 varnish is stated to permit smaller, lighter, and more reliable units. Dow Corning Corp., Midland, Mich.



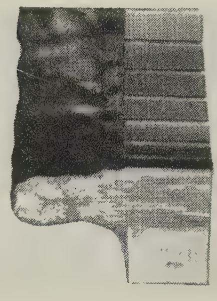
Print No. Ins. 102 on Reader Service Card

New Flame-Retardant Laminate

A new paper-base laminated plastic which combines flame-retardance with excellent mechanical properties has been developed for use as terminal boards, structural insulation parts, insulating washers, and for other applications in radio, aircraft, and switchgear. Known as "Fireban X," the new laminated plastic reportedly complies with Underwriters Laboratories tentative requirements for flame retardance. Essentially a grade X laminate with a special phenolic resin, it is said to provide an extra measure of fire safety in those applications where high tensile and flexural strengths are required. Good impact strength and dielectric strength are also claimed. Offered in sheets approximately 49" x 49", 1/32" to 1" thick. Taylor Fibre Co., Norristown, Pa.

Print No. Ins. 103 on Reader Service Card

Single-Component Epoxy Insulation For Stator End Windings and Slots



A new single-component epoxy insulating compound has been developed for simultaneous encapsulation and impregnation of stator end windings and slots by the vacuum dip process. "Thermopoxy" U-854, is a thixotropic compound which reportedly eliminates the need for molding stator end windings and slots, resulting in lower production costs, simplified handling, and cooler operations. The Sterling Varnish Co., Haysville Borough, Sewickley, Pa.

Print No. Ins. 104 on Reader Service Card

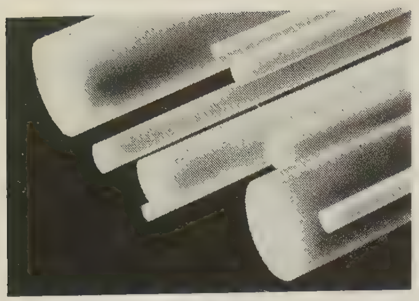
New High-Purity Aluminas

Four new high-purity, finely divided alpha and gamma aluminas are available for use in electrical ceramics, preparation of radio tube wire coatings and fluorescent lamp phosphors, and other applications. Each type is controlled within a narrow range of particle size. The alpha aluminas vary from 0.02 to 0.4 microns and from 99.7% min to 99.96% min Al_2O_3. The gamma aluminas vary from 0.002 to 0.1 microns and from 99.7% min to 99.96% min Al_2O_3. Data sheets and development samples of each are available. J. T. Baker Chemical Co., Phillipsburg, N.J.

Print No. Ins. 105 on Reader Service Card

"Delrin" Rods for Electrical Uses

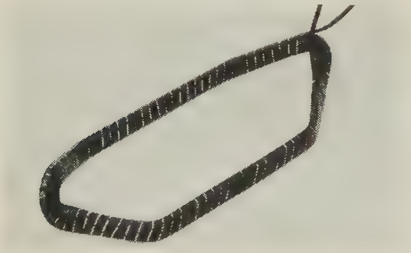
Delrin acetal resin, a recently-developed thermoplastic material, is now available in extruded rods up to three inches in diameter. Outstanding tensile strength, rigidity, fatigue life, resistance to creep and solvents at both room and elevated temperatures, excellent dimensional stability, and good electrical and frictional properties are claimed. The rods have a hard glossy surface with a low dissipation factor and dielectric constant over a wide range of frequencies at normal and elevated temperatures. Low moisture absorption and low permeability add



to their ability to maintain good electrical properties even under high humidity exposure and after complete immersion in water. Delrin is easily machined (similar to free cutting brass) on standard machine shop equipment and can be blanked and punched to produce smooth, all flat parts. The Garlock Packing Co., 441 Main St., Palmyra, N.Y.

Print No. Ins. 106 on Reader Service Card

Triangular Guide Line Tape For Class H Insulation



PSR-2800 triangular guide line tape for insulating form-wound motor coils is made of self-bonding unsupported silicone rubber. Its triangular cross-sectional shape reportedly allows it to be half-lapped around complex shaped coils and wires to give a smooth, ridge-free and void-free build-up. The center guide line insures an easy and uniform wind and eliminates gapping in the wrap. Various tape thicknesses are identified quickly by color coding the guide lines. PSR-2800 is said to be a class H insulator with excellent chemical, dielectric, and physical stability over a temperature range of —130 to +500°F (—90 to +260°C). While primarily a coil wrap. PSR-2800 is also recommended for field repairs of class H electrical equipment, wrapping bus bars and stator coils, electrical coils which are temperature-sensitive, and complex cable harnesses. PSR-2800 bonds to itself under normal contact pressure and strength is built up under aging at room temperature. Bond strength can be improved by post-curing for several hours at accelerated temperature. Permacel, New Brunswick, N.J.

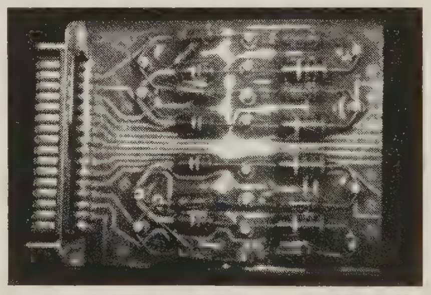
Print No. Ins. 107 on Reader Service Card

New Etching Solution Makes Fluorocarbon Polymers Bondable

New "Fluoroetch" is an activated form of sodium in solution for making fluorocarbon polymers bondable to other materials. The etching procedure consists of cleaning the polymer surface with a standard industrial solvent and allowing it to dry, masking off areas which are not to be treated, then treating by dipping, spraying, brushing, or spotting. Surface properties of the polymer are said to remain virtually unchanged as a result of the etch. Acton Laboratories, 1180 Raymond Blvd., Newark 2, N.J.

Print No. Ins. 108 on Reader Service Card

Multi-Polymer Resin Coating For Circuit Boards



A new multi-polymer resin coating for binding elements on circuit boards to absorb vibration reportedly may be removed with a soldering iron without being carbonized. This permits removal and replacement of elements on the circuit board without danger of destroying the dielectric properties. PT-412 is said to have good dielectric strength and low water absorption characteristics. Over 80% solid, it flows readily and can be brush coated or thinned for spraying. It may be applied in any desired thickness. A two-component system, it should be mixed just prior to use. Shelf-life after mixing is approximately six hours. PT-412 also is stated to be resistant to acids, alkalies, and solvents. Product Techniques Inc., 511 E. 87th Pl., Los Angeles 3.

Print No. Ins. 109 on Reader Service Card

Two New Electrical Tapes with TFE Fluorocarbon Backings

New "Scotch" brand electrical tape No. X-1111 has a .002″ extruded TFE fluorocarbon film backing coated on one side with a pressure-sensitive adhesive. The adhesive system is designed to have maximum resistance to jet fuels and hydraulic fluids. In addition, the tape is said to have good tack and heat resistance. No. X-1111 is a thermosetting tape recommended for use at class F (155°C) temperatures. New "Scotch" brand electrica tape No. X-1112 has a TFE fluorocarbon impregnated glass cloth backing which is coated with a thermosetting silicone adhesive. Designed fo applications where the cold flow o "Teflon" film is a problem, X-11 reportedly provides added strength and holding power for heavy dut functions while giving greatly improved cut-through resistance. Tap No. X-1112 is recommended for us at Class H (180°C) temperatur Minnesota Mining and Manufacturing Co., Dept. S9-483, 900 Bush Ave St. Paul 6, Minn.

Print No. Ins. 110 on Reader Service Card

Laminated Plastics for Use to 500°F

Two new high-temperature indu trial laminated plastics, grade ARF HT, an asbestos mat base plastic, an grade G3-HT, a glass fabric base plastic, both use modified phenolic resi binders. Grade ARF-HT reportedl can be used at temperatures to 500° (260°C). Flexural strength for grad ARF-HT is 35,000 lengthwise an 25,000 crosswise, psi; compressiv strength, flatwise, is 50,000 psi; tensile strength is 20,000 lengthwise an 12,000 crosswise, psi. Forty percen of the original flexural strength, 90% of the compressive strength, and 40% of the original tensile strength a retained after 1000 hrs at 500° G3-HT also has a recommended temperature resistance of 500°F. Prope ties of G3-HT include: Flexur strength, lengthwise 60,000 and cros wise 50,000, psi; compressive strength 50,000 psi, flatwise; and tensi strength, psi, 30,000 lengthwise an 25,000 crosswise. Percentages of th original strengths retained after 100 hrs' exposure to 500°F are: Flexur strength, 40%; compressive strengt 80%; and tensile strength, 40%. Bot grades are available in sheets a

PROGRESS IN PLASTICS

THE TROUBLE WITH PRINTED CIRCUITS— AND HOW CDF ORKS TO SOLVE IT

e honeymoon is long since over; sup- ers and manufacturers are engaged w in the humdrum activity of making inted circuits *work.* The industry und in time that there was still a long y to go before the *magic* of printed cuitry was proved incontrovertibly in actice. The truth: Too many mass- oduced printed circuits simply were good. Why?

The trouble was not in the theory. Or approved manufacturing techniques. lay—and still lies—in raw materials, imarily in the consistency of quality base laminates.

We're not here to say that CDF has a tally rosy record in this field. No, we've d our share of failures along with our any triumphs. In fact, our failures dur- g the early years of copper-clad lami- tes taught us certain important things at our competitors have yet to learn.

But we do emphasize this: We've ade—and are still making—great prog- ss at CDF in licking problems that ve beset the printed-circuit producer d the printed-circuit user in obtaining p-quality laminates on every order, gardless of grade.

Here, for example, are a few areas here CDF R&D has been particularly tive:

1. Consistent quality. A major cause for printed-circuit rejects has been delamination and blistering of the base laminates when subjected to high temperatures in processing. New developments in CDF raw-materials control promise a heartening break-through in this respect. Also, CDF technical personnel are engaged in counseling circuit manufacturers in optimum handling and processing techniques.

2. Foil-bond strength. Certain metal-clad laminates seem to pass the most rigid laboratory tests, only to fail at the end of manufacture when dipped in solder or when put through long-term operational tests at elevated temperatures. The foil-bonding strength of CDF Di-Clad® laminates, however, is recognized throughout the industry as superior in every grade.

Nevertheless, improvements are being made daily in foil adhesives and bonding methods at CDF, and bond strengths are being increased—not only in number of pounds required for foil separation, but in length of safe solder-immersion and high-temperature operation time.

3. Range of selection. CDF has consistently offered the widest range of metal-clad grades—in phenolic and epoxy paper-base, epoxy-glass, and Teflon*-glass. And CDF Di-Clad Teflon-glass grades remain the only laminates of their kind approved by the military. CDF Technical Bulletin 11,900 gives the latest information on all Di-Clad printed-circuit grades.

4. Flexible grades. Newly-perfected *flexible* grades of CDF Di-Clad promise the designer even greater freedom. One of the headaches in the use of printed circuits has been their rigidity. They tend to hamper independent movement and vibration of connected systems. They occasionally dictate inconvenient housing shapes. Flexible printed circuits, however, overcome these objections and provide many additional benefits of their own. Details on how CDF flexible Di-Clad materials can help see you out of a printed-circuit problem can be obtained from your CDF sales engineer. Look up his phone number in the Product Design File (Sweet's), Electronics Buyers' Guide, or your own CDF catalog. Or send us your print or your problem, and we'll return recommendations based on your individual needs.

NEW CDF LITERATURE

Information on new grades, special applications, and outstanding properties of CDF insulating materials is made available regularly through CDF Technical Bulletins and Folders. The following literature is new. For copies of any bulletins listed, send the coupon below.

CDF Di-Clad Laminates—
Bulletin 11,900
CDF Skived Tapes of Teflon—
Bulletin 97
CDF Pressure-Sensitive Tapes of Teflon
Bulletin 102
CDF Grades Meeting NEMA, ASTM, Federal, and Military Specifications—
Bulletin 10,100
CDF Dilecto® Paper-Base Laminates—
Bulletin 11,110
CDF Dilecto Epoxy Laminates—
Bulletin 11,200
CDF Spiral Tubing—
Bulletin 14,000

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* du Pont's TFE fluorocarbon resin

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strips, and in tube form for special requirements. Synthane Corp., Oaks, Pa.

Print No. Ins. 111 on Reader Service Card

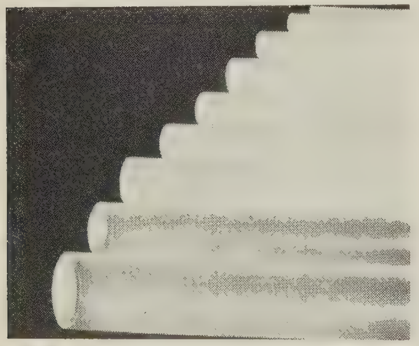
Potting and Casting Resins for Room or High Temperature Cure

Capable of cure with room temperature or elevated temperature curing agents, "Epocast" H-1314 is a new resin specifically developed for encapsulation of electrical components by potting or casting. As a cured product it reportedly will not support combustion after exposure to high temperature flames. Furane Plastics Inc., 4516 Brazil St., Los Angeles 39.

Print No. Ins. 112 on Reader Service Card

Nylon Tubing for Electrical Uses

Nylon tubing in a wide variety of diameters and wall thicknesses is now available for use as flexible cable casing, heater and vent control cable casing, and wire cladding. Continuous lengths in sizes from .010″ x .060″ to .280″ x .500″ are supplied. Special sizes available. The Garlock Packing Co., 440 Main St., Palmyra, N.Y.



Print No. Ins. 113 on Reader Service Card

New "Teflon" Film Adhesive Tape

New Permacel 423 tape, a two-mil Teflon film with a pressure-sensitive adhesive, reportedly can be used in electrical applications for holding and insulating where a class 180°C tape is required, for coil wrapping, and as a conductor insulation for armature and field coils. It is printable with ordinary printing inks. An interliner is provided to facilitate die-cutting into any desired shape. Permacel, New Brunswick, N.J.

Print No. Ins. 114 on Reader Service Card

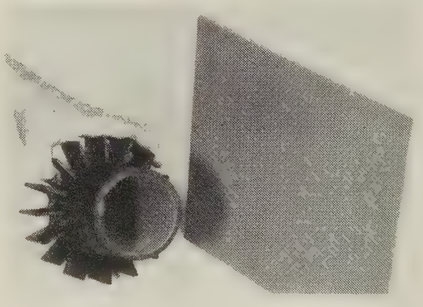
Epoxy Potting and Casting System for Electronic Components of All Sizes

A new epoxy potting and casting system, RCM resin 8 and curing agent T, has been developed for use on all sizes of electronic components subject to thermal and mechanical shock. The system is said to be formulated with an internal flexibility without the incorporation of any type of plasticizer. Excellent electrical and physical properties are reported to result from a room temperature cure. The nontoxic system has a pot life of three hours at room temperature and is claimed to meet the requirements of MIL-T-27A, class B. Electrical properties include dielectric strength of 350 vpm, dielectric constant of 3.8, loss factor of 0.087, and volume resistivity of 9.0 x 10^{15} at 77°F and 1.2 x 10^{11} at 200°F. Resin Consultants & Manufacturing Co. Inc., 132 Nassau St., New York 38.

Print No. Ins. 115 on Reader Service Card

Bulk-Resistive Ceramic Foams

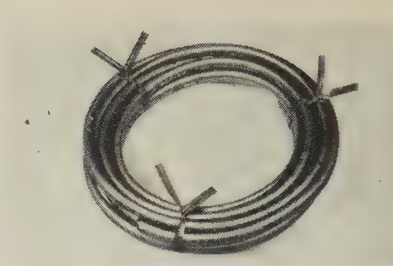
New "Eccosorb" BR bulk-resistive ceramic foams are said to be particularly useful in microwave components such as attenuators, terminations, and loads. Available in sheet form, the materials weigh approximately 20 lbs/cu ft and reportedly are easily machined to wedges, tapers, etc. *BR 240* has a dielectric constant of 15.0 and a dissipation factor of 3.0 at a frequency of 10^{10} cps. Volume resistivity is 100 ohm-cm. *BR 250* has a dielectric constant of 7.0 and a dissipation factor of 2.0 at 10^{10} cps, with a volume resistivity of 2,500 ohm-cm. *BR 260* has a dielectric constant of 3.0 and a dissipation factor of 0.5 at 10^{10} cps, with a volume resistivity of 50,000 ohm-cm. Emerson & Cuming Inc., 869 Washington St., Canton, Mass.



Print No. Ins. 116 on Reader Service Card

New Plastic Tie for Wire and Cable

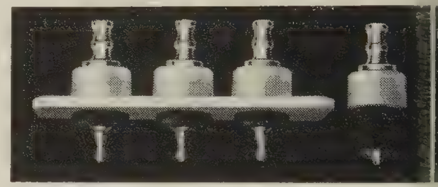
New "Plas-Ties" are said to tie securely with a single twist and may be used for tying coils of wire and cable, or marking wire, other items, and cables in circuits. Made of vinyl plastic with a wire core, they are strong and waterproof, do not peel apart, and can be used many times. They are supplied in a wide variety of colors, in lengths from 2″ and in widths from ⅛″. Samples available. Plas-Ties Co., 624 Poinsettia, Santa Ana, Cal.



Print No. Ins. 117 on Reader Service Card

Non-Turning Hermetic Terminal

New 599 hermetic terminals are designed for electronic components such as transformers, capacitors, etc., in the intermediate voltage range—1500 v operating. The 599 non-turning hermetic terminal is a single-unit assembly (no loose parts). It reportedly meets MIL-T-27A specifications. Advantages claimed include moderate cost, easy installation which saves at least 50% in installation costs, and simplified inventory control. Bulletin and samples available. Lundey Associates, 694 Main St., Waltham 54 Mass.



Print No. Ins. 118 on Reader Service Card

Heavy-Duty Wire Stripper Removes Film or Bonded Insulations

The Model 12 twin wheel wire stripper is a new machine especially designed for the removal of enamel "Formvar," nylon, "Cerox," glass "Teflon," and other film and bonded type insulations or combinations of these insulations. It handles sizes from AWG No. 17 to AWG No. 45 either single or stranded electrical conductors. Model 12 reportedly removes all known types of film insulation without damage to the conductor through extremely high-speed wheel rotation. Either 1″ or 2″ width fibre glass or wire stripping wheels are

VITAL PART OF YOUR
INYL INSULATION...
THE RIGHT PLASTICIZER

he service life and performance of your vinyl insution compound center around its plasticizer. In ddition to providing good electrical properties, the ohm & Haas plasticizers listed here impart excep onal resistance to plasticizer extraction by water, apy water, and oil. They have very low volatility, nd high resistance to migration into lacquers, baked namels, rubber, and polystyrene. Furthermore, inyls using these plasticizers show excellent etention of physical properties on exposure to igh temperatures. Key uses for the individual rades include:

ONOPLEX S-90E—applications requiring retention resistivity, tensile strength, and elongation after ng-term high-temperature aging (either dry, im ersed in water, or exposed to high humidity).

ARAPLEX G-54—standard appliance wire, including 5°C insulation; has particular merit wherever 1) tention of compatibility under high humidity xposure and 2) freedom from plasticizer migration into polystyrene, rubber, lacquers and other coatings are required.

PARAPLEX G-50—also for standard appliance wire, particularly when cost is an important factor.

PARAPLEX G-62—provides stabilization against heat; ideal for high-temperature insulation; also can be used in stabilizer quantities with general purpose plasticizers in lower-cost wire such as extension cords.

Get technical information on these and other Rohm & Haas plasticizers. Write for a copy of *What You Should Know about* PARAPLEX *and* MONOPLEX *Plasticizers.*

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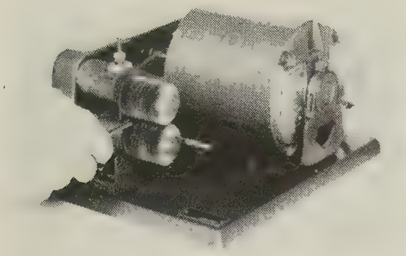
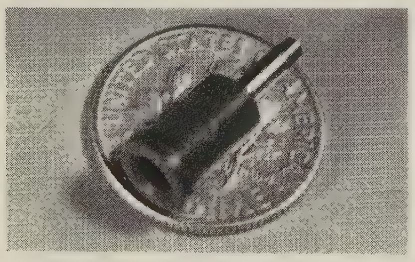


used. Model 12 is a high production machine capable of time, effort, and skill reduction requiring little training on the part of the operator. It is said to be precision engineered and provided with simple, readily accessible adjustments to meet every type of insulation removal requirement. Net weight is 22 lbs. Size is 9½″ in width, 11″ deep, and 6¼″ high. Powered by a ¼ hp motor, 110 v, 60 cycle. Price is $175. Carpenter Manufacturing Co. Inc., DeWitt 14, N.Y.

Print No. Ins. 119 on Reader Service Card

Easier Working Miniature Probe

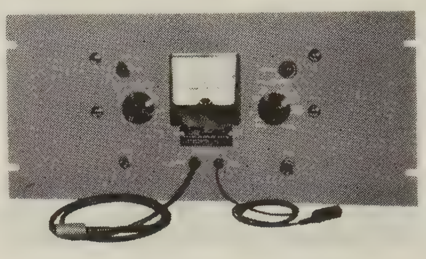
Greater insertion and withdrawal ease are said to result from new design of PR-302 "Mini-Probes." Retaining the same features as the previous PR-300 in-line plug, this probe takes the stripped wire end to its tip where it can be neatly dip-soldered without interfering with insertion and withdrawal. The tip has a shoulder for gripping the probe, making it easier to push in or pull out of a mating "Press-Fit" jack. Available in 11 code colors. Sealectro Corp., 139 Hoyt St., Mamaroneck, N.Y.



Print No. Ins. 120 on Reader Service Card

New Rack Panel Mount Megpot High Potential Test Set

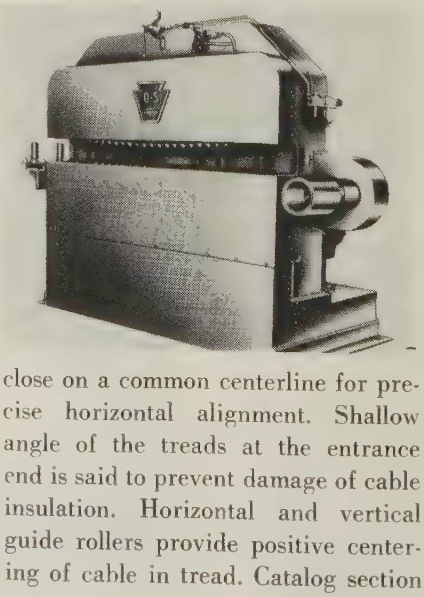
A new rack panel mount high potential test set, No. 570RP Series, is said to assure non-destructive dielectric testing of transformers, relays, capacitors, and complete electronic assemblies through a quick acting relay that cuts current from components under test in milliseconds and to provide continuously variable leakage tests with settings from 20 μa to 3 ma. Variable ranges to 10,000 v are available, with standard models ranging from 0 to 3000 v or 0 to 5000 v a-c. The voltage is read directly across the output leads. Accuracy of ±5% over the entire voltage range is claimed. The set is designed for modular installations to provide easy mounting into all types of consoles or panel control instrumentation set-ups. Data sheet No. 570RP available. General Hermetic Sealing Corp., 99 E. Hawthorne Ave., Valley Stream, L.I., N.Y.



Print No. Ins. 121 on Reader Service Card

New Wire and Cable Capstan

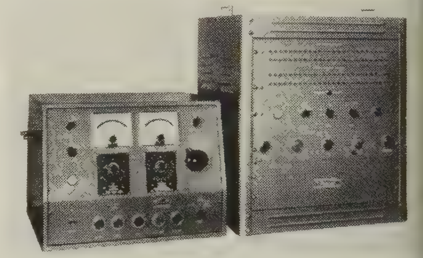
A new general purpose caterpillar capstan for large diameter wire and cable insulating lines, Model MDC, is rated for 2500 lbs pulling capacity at speeds up to 250 ft/min. The special tread design provides a "wrap around" grip on cables from 5/16″ to 5″ diameter. Pneumatically controlled tread pressure up to 400 psi is available on only 70-75 lbs of air. Extremely low air consumption is an outstanding feature of the capstan. Upper and lower treads open and close on a common centerline for precise horizontal alignment. Shallow angle of the treads at the entrance end is said to prevent damage of cable insulation. Horizontal and vertical guide rollers provide positive centering of cable in tread. Catalog section 7.6 available. Davis-Standard, Div. of Franklin Research Corp., Mystic, Conn.



Print No. Ins. 122 on Reader Service Card

Insulation Life Tester Makes 12-Hour Unattended Test

New model 8515 insulation life tester operates automatically for periods up to 12 hours while making high voltage breakdown tests on as many as 50 test samples of transformers, motors, capacitors, cables, bushings, switchgear, and other electrical equipment as well as insulation samples. Individual components or circuits are automatically tested in sequence, at the pre-set potential. Model 8515 may be set so that when breakdown or leakage current in excess of a predetermined value develops, it will sound an alarm and shut off completely, or continue checking the balance of the units but drop to zero the test potential on the unit that has failed. Indicator lights show which unit has failed and also which unit is under test. A d-c test potential that may be set for any value to 20 kv is provided by the Model 8514 "Hypot" high voltage test set used in conjunction with Model 8515. The rate of rise for this test potential and the length of time it is applied to each unit (up to 15 minutes) is adjustable. Associated Research Inc., 3777 W. Belmont Ave., Chicago 18.



Print No. Ins. 123 on Reader Service Card

Equipment Facilitates Epoxy Potting of Coils and Assemblies

A packaged unit that simplifies the use of two-part epoxy compounds, the "Auto-Rez-Mixer" will proportion, meter, mix, and dispense multicomponent reactive resins. Short pot-life resin mixes reportedly can be handled with ease and safety. Simplified push-button operation automates the handling of epoxy resin mixes for potting, embedment, encapsulation, im

Why Du Pont insulation s in a class by itself

ach of these electrical insulating
aterials—Du Pont coated glass fab-
s—more than meets the industry
andards of its class. As you look
er the data, you'll note outstand-
g chemical and mechanical charac-
ristics as well as electrical—better
operty balance.

Du Pont insulation is unmatched
performance. You'll discover it is
markably uniform in caliper...can
ve you greater design freedom,
ake your product more reliable, re-
ce your rejects. And for particular
sulation problems, Du Pont Techni-
l Service is available to assist you.

For details, complete data on these
Pont coated fabrics—mail the cou-
n today. Or write E. I. du Pont de
emours & Co. (Inc.), Fabrics Division,
pt. I-02, Wilmington 98, Delaware.

ARMALON® TFE-fluorocarbon resin coated glass fabric

Serviceable from −125°F to +482°F (Classified as Class H insulation)

GENERAL PROPERTIES

- Unusual heat resistance
- Mechanical strength and extreme toughness
- Low flow under heat and pressure
- Excellent electrical characteristics over a wide range of temperatures and frequencies
- High degree of chemical inertness
- Excellent anti-adhesive, non-stick properties
- Low water absorption
- Outstanding flame resistance

SPECIFIC PROPERTIES* of single ply	3 mils	6 mils
Dielectric strength (¼″ electrode)	> 750	> 500
Surface arc resistance, sec.	> 180	> 180
Dielectric constant		
60 cycles	1.8	2.3
1,000,000 cycles	1.7	1.8
Volume resistivity, ohm-cm		
room conditions	10^{19}	10^{19}
300°C	10^{13}	10^{13}
Insulation resistance, ohms (96 hrs. @ 90% R.H., 25°C)	10^{8}	10^{8}
Breaking strength, lbs./in. of width, warp	> 40	> 50

Note: Standard single-ply constructions — available in 4, 5, 8, 10 mils, also — come in rolls or sheets ¼″ to 38″ wide; laminates in rolls or 13″ x 17″ sheets—6 to 25 mils thick.

LECTON® acrylic resin coated glass fabric

Serviceable at 226°F continuously, to 310°F intermittently (Classified as Class B insulation)

GENERAL PROPERTIES

- Good heat resistance
- Mechanical strength and extreme toughness
- Dimensional stability
- Good retention of electrical characteristics to 310°F and under high humidity conditions
- Highly resistant to most solvents, transformer oils, fluorinated hydrocarbon refrigerants
- Good resistance to nuclear radiation
- Modest price

SPECIFIC PROPERTIES* of single ply	3 mils	7 mils	14 mils
Dielectric strength (¼″ electrode)			
@ 25°C	> 1000	> 800	> 600
@ 130°C	> 700	> 600	> 500
@ 25°C after 4 days at 90% R.H.	> 900	> 700	> 550
Surface arc resistance, sec.	> 180	> 180	> 180
Volume resistivity, ohm-cm			
@ 25°C	10^{14}	10^{14}	10^{14}
@ 130°C	10^{12}	10^{12}	10^{12}
@ 25°C after 4 days at 90% R.H.	10^{14}	10^{14}	10^{14}
Breaking strength, lbs./in., average, W X F			
straight	90x150	140x120	250x250
bias-cut		55	
Elongation at rupture, %			
straight	3	3	3
bias-cut		35	

Note: Standard single-ply constructions — available in 5, 10 mils, also — come in rolls or sheets ¼″ to 60″ wide; 7 and 10 mils offered both straight and bias-cut. Laminates supplied in rolls 20 and 30 mils thick, and in 18″ x 18″ sheets .060″, .072″, or 3/32″ thick.

FAIRPRENE® silicone rubber coated glass fabric

Serviceable from −70°F to +480°F (conforms to Spec. MIL-C 21948)

GENERAL PROPERTIES

- Excellent high-temperature resistance
- Good electrical characteristic
- Excellent corona resistance
- Low-temperature flexibility
- Puncture resistance

SPECIFIC PROPERTIES* of single ply	7 mils	10 mils
Dielectric strength (¼″ electrode)	> 500	> 500
Tensile strength, lbs.	130 x 110	150 x 140
Tear strength, lbs.	8 x 10	8 x 10
Burst strength	350 psi	400 psi
Oil resistance 70 hrs. @ 350°F in ASTM #1 oil		
volume change	+5%	+4%
decomposition	none	none
surface tack	none	none

*Derived from standard testing methods. These data are a guide to properties and are not to be regarded as specifications.

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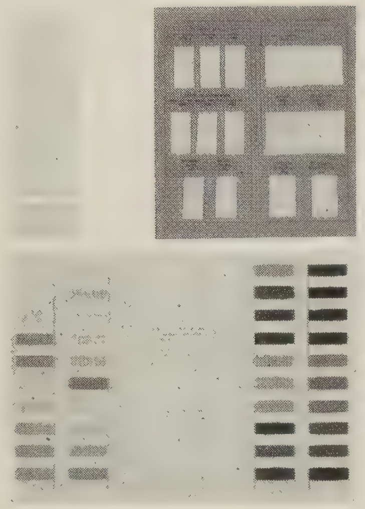

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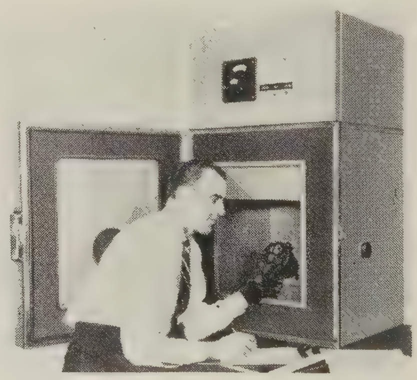
pregnation, casting, and adhesive applications. Adjustable measured shots are dispensed on singal. A valve which provides sharp cut-off of highly viscous or filled resins is featured. Heating, agitation, deaeration, and dispensing under vacuum are available. C.P.M. Special Machinery Corp., 324 Butler St., Brooklyn 17, N.Y.

Print No. Ins. 124 on Reader Service Card

New Environmental Test Chambers

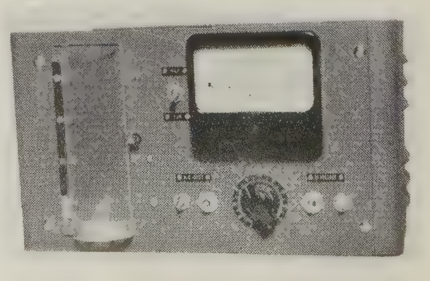
The "ValuMite" environmental test chamber is designed to meet low and high temperature testing needs of the missile component field. The bench mounting unit features 2 cu ft of stainless steel test space, mechanical refrigeration cooling to −100°F, electrical heating to +250°F, precision temperature control with a 1°C temperature tolerance, and viewing-utility ports. International Radiant Corp., 577 East 156th St., New York 55.



Print No. Ins. 125 on Reader Service Card

Magnet Wire Tester and Hipot

Designed for testing samples of magnet wire (twist test) in accordance with military and commercia standards, Model P5 AC-T features a transparent test cage mounted on th front panel to receive the specimer pieces. Ends of the magnet wire sli into miniature mercury cups to facilitate contact without scraping insulation. Other features include continuously adjustable testing voltage from zero to 5000 v rms, a dual scale k meter for accurate setting of test voltage, a push-button high voltage "ON" control actuating a holding type con tactor, plus usual safety and con venience controls. The unit also ma be used as a standard hipot tester b plugging test leads into high voltag jacks at the rear of the unit. Pesche Electronics Inc., Towners, Patterso N.Y.



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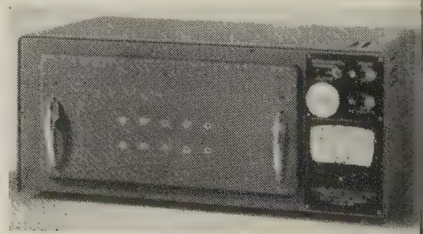
Portable Temperature Chamber

The new 1060 series of portabl temperature chambers featuring temperatures which can be maintaine within ±0.2°F over a range −100°F to +500°F includes a rac mounted model with test volume 10″ x 7″ x 7″, two bench models wit the same test volume, and a wid drawer model with test volume 16″ x 7″ x 7″. Liquid CO_2 automat cally cools three of the new chamber while dry ice (solid CO_2) is used i the fourth chamber. Heating is b 650-watt electric elements. The liqui CO_2 cooled chambers, in addition providing extremely fast temperatu pull-down, can be programmed wi a simple auxiliary timer to alterna between a high and a low temper ture. Delta Design Inc., 3163 Adar Ave., San Diego 16, Cal.



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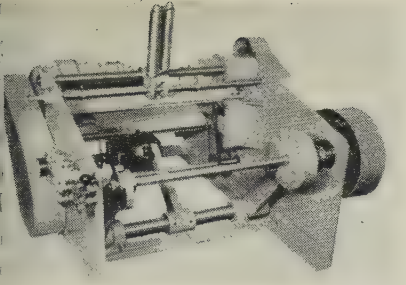
New 36″ Single Reel Take-Up For Wire Insulating Lines

A new 36″ single reel take-up f wire insulating lines, Model SR 36, designed for wire speeds up to a exceeding 2000 fpm. It handles ree

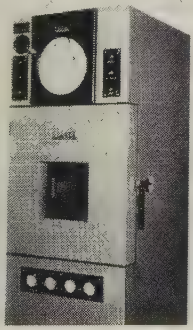


›m 12″ to 36″ in diameter and up 24″ wide. Full reels up to 2000 lbs n be accommodated. The take-up s pneumatic reel arms, adjustable g pin and infinitely adjustable iverse lay and movement. The ball- aring-mounted wire guide rolls ac- pt wires from "0" gauge to ¾″. italog section 8.7 available. Davis- andard, a division of Franklin Re- arch Corp., Mystic, Conn.

nt No. Ins. 128 on Reader Service Card

w Mobile Environmental Chamber r Research and Testing

A new mobile environmental cham- r with a range from —125°F to 350°F has wide application in re- arch, testing, and conditioning of rts and products. Model AF-1.5- 5+350 has entrance ports at the ıor for instrument cables which iminate the usual feed-through ports id terminal panels. Temperatures portedly can be lowered from 350°F to —100°F in 50 minutes,



d raised from —100°F to +350°F 30 minutes. Accuracy claimed is 2°. Other features include a 24- ur recording chart, interior light- g, multi-pane thermal glass assem- y in the door, hermetically sealed ating elements, and special safety ntrols. Interior dimensions are 14″ 14″ x 14″. The unit requires floor ace of 26″ x 32″. Webber Manu- cturing Co. Inc., P.O. Box 217, dianapolis 6, Ind.

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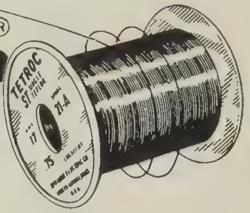

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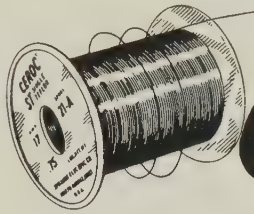

FOR CONTINUOUS OPERATION AT
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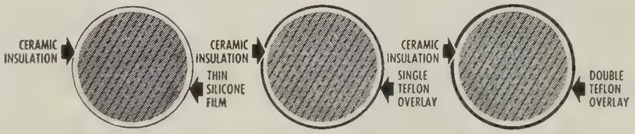
UP TO 250°C



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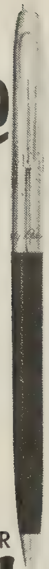

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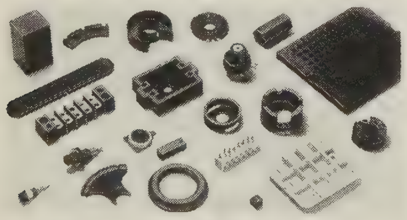

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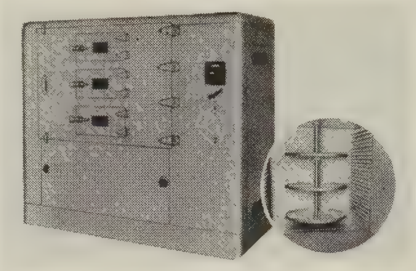
New Rotary Shelf Ovens

Extra precision control of heat uniformity for laboratory or production is said to be provided by a new rotary shelf laboratory oven. The rotary shelves, either manually or mechanically operated, are spaced on 12″ vertical centers. Manual operation is recommended for temperatures below 300°F. For higher temperatures to the oven maximum of 850°F, a motor and reduction gear maintain constant shelf rotation. The rotary shelf oven comes in all sizes of Despatch "V" oven series. This series can be supplied for gas, electric, or steam heat. It utilizes forced convection with horizontal air flow. Even without the rotary shelf this model reportedly maintains heat uniformity within ±1°C. The rotary shelf is said to give identical heat to every product placed on the shelves. Other features include hinged plug-type doors located within one main door on the same level as the rotary shelf for easy removal of the product. Each door is provided with a heat-resistant glass window. Catalog available. Despatch Oven Co., 619—8th St., S.E., Minneapolis 14, Minn.



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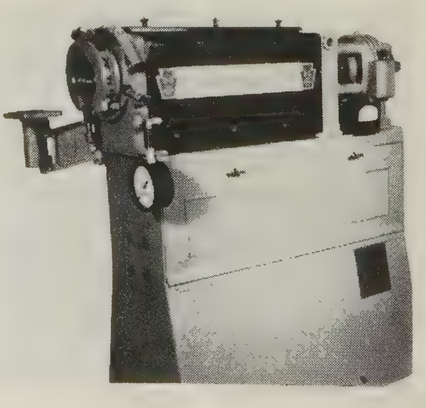
New Laboratory Extruder

A new 1½″ "Thermatic" plastic extruder designed for laboratory and experimental production, Model 15T, is designed for speeds up to 400 rpm and features production rates of 100 lbs/hr at 3000 psi. Separate, high-capacity thrust and radial bearings are rated for an average life of more than a half-million hours. This new 1½″ model utilizes deep aluminum "Therma-Fins" which reportedly provide excellent cooling for all requirements. Catalog section 3.12 available. Davis-Standard, Div. of Franklin Research Corp., Mystic, Conn.



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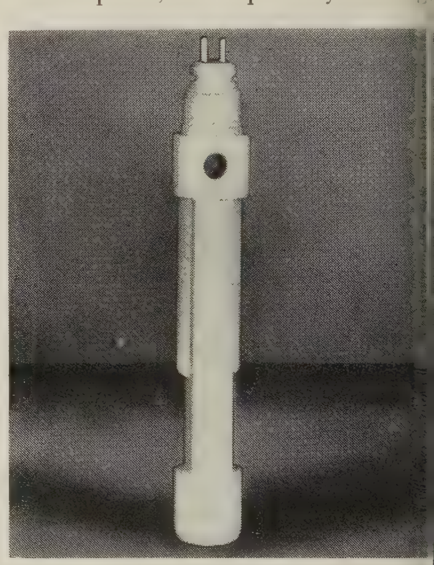
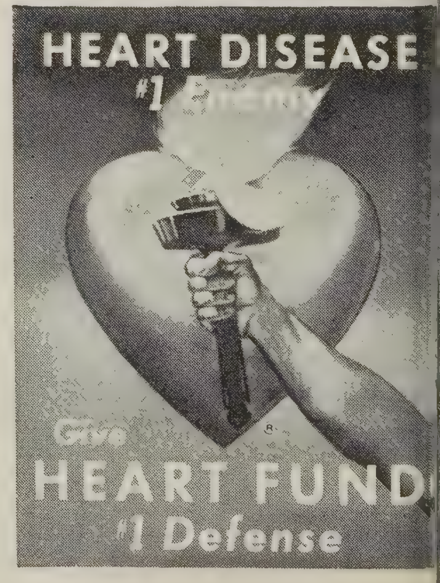
"Teflon" Protects New Conductivity Cells

New conductivity cells have a plastic body molded of Teflon FEP. The cells, manufactured for Leeds and Northrup Co., are a primary sensing device for the electrolytic conductivity of solutions. Moldings are provided by the United States Gasket Co., Camden 1, N. J.





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xible extruded tubing made from
lyvinyl chloride resins also contains
ctrical and other property data as
ll as standard dimensions and tol-
ances. Three of the grades meet
rious MIL specifications. The 14
mples are 2½" to 6" long in clear
d representative colors. An elastic
nding permits the samples to be re-
oved and replaced at will. Insulation
anufacturers Corp., 565 W. Wash-
gton Blvd., Chicago 6.

nt No. Ins. 201 on Reader Service Card

operty and Price Sheet on
ack-Resistant Insulation

New specification sheet lists proper-
s and prices for "Resistrac" fiber
ass alumina-polyester, a track-re-
stant insulation for service in humid,
ntaminated atmospheres. A com-
nion sheet covers track resistance
material and five other laminates.
e Glastic Corp., 4321 Glenridge
l., Cleveland 21, Ohio.

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chnical Literature on Impact
lystyrene Molding Compounds

Volume 5, Number 1 of "Bakelite
olding News" gives electrical, me-
anical, fabricating, and other data
d applications for four impact pol-
tyrene molding compounds. 16
ges. Union Carbide Plastics Co., 30
st 42nd St., New York 17.

nt No. Ins. 203 on Reader Service Card

lder on High Temperature
ectrical Insulating Materials

Revised folder summarizes design
d application data on company's materials for high temperature electrical and electronic insulation and for gasketing and sealing requirements. Rogers Corp., Rogers, Conn.

Print No. Ins. 204 on Reader Service Card

Folder on Precision Machining And Fabricating of Plastics

Precision machining and fabricating of plastic sheets, films, rods, and tubes for electronic and electrical insulation applications and other uses are illustrated in new folder. Operations illustrated include turning, milling, contour cutting, Pantograph engraving, press-punching, grinding, drilling and tapping, sawing, screw machining, jig boring, slitting, decorative and identification printing, sanding, and quality inspection of finished fabricated parts. 4 pages. Insulating Fabricators Inc., 154 Union Ave., East Rutherford, N.J.

Print No. Ins. 205 on Reader Service Card

Product Listing Includes Chemicals And Plastics for Insulation

Company product listing for 1960 includes a comprehensive line of chemicals and plastics for use in electrical/electronic insulation and other applications. Plastics listed include epoxy, phenolic, polyethylene, polystyrene, silicone, and vinyl resins and compounds, vinyl film and flexible and rigid sheeting, vinyl coated paper, vinyl foam, and polyethylene film. Some of the chemical products listed include solvents, intermediates, monomers, plasticizers, surface-active agents, and silicone oils, resins, and elastomers. 16 pages. Union Carbide Corp., 30 East 42nd St., New York 17.

Print No. Ins. 206 on Reader Service Card

Laminated Plastic Catalog

New catalog on laminated plastic sheets, rods, and tubes lists more than 50 grades available with sizes, properties, and special features of each; illustrates typical applications; and gives fabricating and finishing information. Detailed electrical data is given. Epoxies, silicones, phenolics, and melamines with paper, cotton, glass, and nylon bases as well as copper-clad laminates for printed circuits are included. 18 pages. Cadillac Plastic & Chemical Co., 15111 Second Ave., Detroit 3.

Print No. Ins. 207 on Reader Service Card

Literature on Flexible Epoxies In Pre-Proportioned Cartridges

New catalog and processing technique sheets illustrate and describe the many immediate-use advantages of EPD flexible epoxy resins in cartridge form for potting electrical connectors and cable junctions. Dept. L4, Chemical Div., Electronic Production & Development Inc., 501 N. Prairie Ave., Hawthorne, Cal.

Print No. Ins. 208 on Reader Service Card

Slit Plastic Film, Paper, and Combination Insulations Bulletin

New bulletin No. 33, "Commercial Precision Slitting," contains tables listing 10 electrical grade slit plastic films, papers, and combinations with thicknesses, widths, tolerances, and coil and core sizes in which each is supplied. "Teflon," polyethylene, "Mylar," rag paper, kraft paper, fishpaper, and combination insulations are included. Handy conversion tables are included for translating area to lineal feet per pound. Brief notes on the application of each material are given. 4 pages. Inmanco Div., Insulation Manufacturers Corp., 565 W. Washington Blvd., Chicago 6.

Print No. Ins. 209 on Reader Service Card

Data Book on Electrical Insulating Products

Data book on electrical insulating products lists properties of company's line of paper, film, cloth, silicone rubber, and laminated electrical tapes; "Teflon" products; epoxy resin systems; and plastic tapes and metal foils. Government self-sticking tape specifications and a chart of comparable products produced by other manufacturers is also included. 12 pages. Electrical Market Sales Dept., Permacel, New Brunswick, N.J.

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Data and Samples of Line-Clamp Insulation-Cushioning Materials

Folder contains technical data and sample of new AW insulation-cushioning material for clamps and line supports in rockets and missiles. AW cushion is said to prevent malfunctions caused by decomposition of insulation, leaving bare metal of clamp exposed. TA Mfg. Corp., 4607 Alger St., Los Angeles 39.

Print No. Ins. 211 on Reader Service Card

Wire and Cable Data Sheets

Simple, composite, color-coded data charts printed both sides on four durable 8½" x 11" cards with universal binder punch contain information on various types of wires, cables, and power cords. The price sheet gives list prices, stranding, strand diameters, temperature ratings, cutting and paralleling charges, and reel deposits. The weight sheet lists net weights, standard shipping weights, standard put-ups, shipping lengths, and reel dimensions and weights. The diameter and wall thickness sheet specifies overall diameters, with insulation and jacket wall thicknesses. The specification sheet contains listings of most used specifications, their issuing agencies, and the types of wires in the specifications with their voltage ratings and approval numbers. Dept. I, Hatfield Wire & Cable Div., Continental Copper & Steel Industries Inc., Hillside 5, N.J.

Print No. Ins. 212 on Reader Service Card

Bulletin on Test for Corrosiveness Of Printed Circuit Resin Fluxes

New bulletin describes and illustrates results of a U. S. Signal Corps mirror test for corrosiveness of seven printed circuit resin fluxes. The bulletin can be used as a reference chart for selecting a proper soldering flux. London Chemical Co. Inc., Dept. IN-2, 1535 North 31st Ave., Melrose Park, Ill.

Print No. Ins. 213 on Reader Service Card

Zipper Tubing Catalog

New catalog Z-2 discusses the characteristics, new constructions, applications, specifications, and production advantages of zipper tubing for harnessing and cabling. How-t use instructions, permanent sealir directions, accessories listing, ar ordering information are included. addition, new all-in-one forming, clo ing, and sealing equipment for zipp tubing and a new hand tool for bend work on zipper tubing are illustrate and described. Alpha Wire Corp., 2 Varick St., New York 14.

Print No. Ins. 214 on Reader Service Card

Rack and Panel Connector And Coaxial Cable Brochure

New brochure describes and ill trates a line of rack and panel co nectors and RG/U type coaxial, "Te lon" coaxial, and high temperatu miniature cables. 4 pages. Schweb Electronics, 60 Herricks Rd., Mineo L.I., N.Y.

Print No. Ins. 215 on Reader Service Card

Line Clamp Literature

Bulletin TA209G describes a n kind of hinged line fastener with sulating cushions for electrical a other lines of ¼" to 6". Engineeri drawings and illustrations are cluded. 2 pages. TA Mfg. Corp., 46 Alger St., Los Angeles 39.

Print No. Ins. 216 on Reader Service Card

New Environmental Test Equipment Catalog

New short-form catalog descri and illustrates 13 types of en ronmental test equipment. Dim sions, prices, and temperature/ midity ranges are listed. 2 pag Associated Testing Laboratories In 401 Clinton Rd., Caldwell, N.J.

Print No. Ins. 217 on Reader Service Card

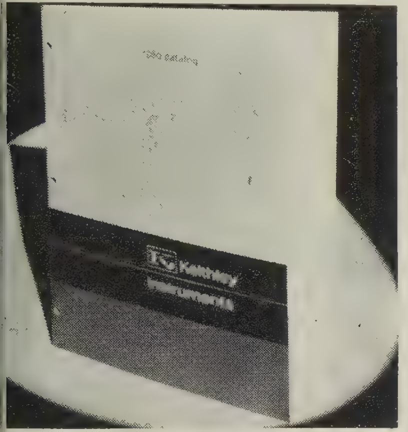
Seal and Fastener Catalog

A new general catalog (No. 359 illustrates and describes an entire l of high-pressure, vibration-resist seals and fasteners. Complete tab data, military and commercial sp fications, brief descriptive text, engineering drawings are provi for "Hexseal" toggle-switch bo push-button switch boots, and rot shaft seals; "Seelskrew" self-seal fasteners; "Seelbolts"; "Seelrivit "RubRglas-Seel" transparent flexible wide-angle boots for sea circuit breakers and indicator ligh

d other products. The catalog is in-
xed and contains a page listing en-
ieering representatives and distrib-
ors. 16 pages. A.P.M. Corp., 252
wthorne Ave., Yonkers, N.Y.
t No. Ins. 218 on Reader Service Card

ctronic Instruments Catalog

New catalog describes and illus-
tes instruments for electronic meas-
ement and control, lists specifica-
ns and performance data, and con-
ns schematic diagrams and appli-
ion circuits. Basic information on
ctrometers and micro-ammeters is



luded. Megohmmeters and other
truments and accessories are cov-
d. 32 pages. Keithley Instruments
., 12415 Euclid Ave., Cleveland 6,
io.
t No. Ins. 219 on Reader Service Card

stic Machinery Bulletin

A new product line bulletin illus-
tes and describes plastic extruders,
sting roll units, take up equipment,
nbination overhead pinch roll and
e up units for blown tubular film,
sheeting line, and packaged mono-
ment equipment. 4 pages. Modern
astic Machinery Corp., 64 Lakeview
e., Clifton, N.J.
t No. Ins. 220 on Reader Service Card

letin on Precision Balls

New bulletin BU-1, covering a line
precision balls, discusses raw ball
terials, methods of manufacture,
ecision, finish, sizes, and quantities.
atured are standard balls of such
terials as synthetic sapphire, nylon,
d others. Maximum temperature
most uses, electrical resistance,
d other physical and chemical prop-
ies and recommended uses are

listed. 8 pages. Industrial Tectonics Inc., P.O. Box 606, Ann Arbor, Mich.

Print No. Ins. 221 on Reader Service Card

Ultra-Temp Oven Brochure

New bulletin No. 6950 contains complete construction details, voltages, prices, and sizes of ultra-temp ovens for applications requiring temperatures to 1300°F. 4 pages. Blue M Electric Co., 138th and Chatham St., Blue Island, Ill.

Print No. Ins. 222 on Reader Service Card

Literature on Machine for Slicing Brittle Ceramics

Technical data sheets and an article reprint describe the new "Microtom-Atic" slicing machine Model MTA-7 for producing thin, accurate slices of brittle, shock-sensitive semiconductor and ceramic materials—quartz, barium titinate, aluminum oxide, lead zirconite, and others—at high sustained production rates. 7 pages. The DoAll Co., Des Plaines, Ill.

Print No. Ins. 223 on Reader Service Card

Bulletin on Automatic Motor Slot Cell and Wedge Inserting Machines

New illustrated bulletin 598CW describes automatic motor slot cell and wedge inserting machines, lists capacities, specifications, dimensions, and

other features, explains operation, and points out equipment investment and operating cost savings possible. 4 pages. Possis Machine Corp., 1645 Hennepin Ave., Minneapolis 3, Minn.

Print No. Ins. 224 on Reader Service Card

CHR
SILICONE RUBBER TAPES
CLASS H SUPPORTED TAPES

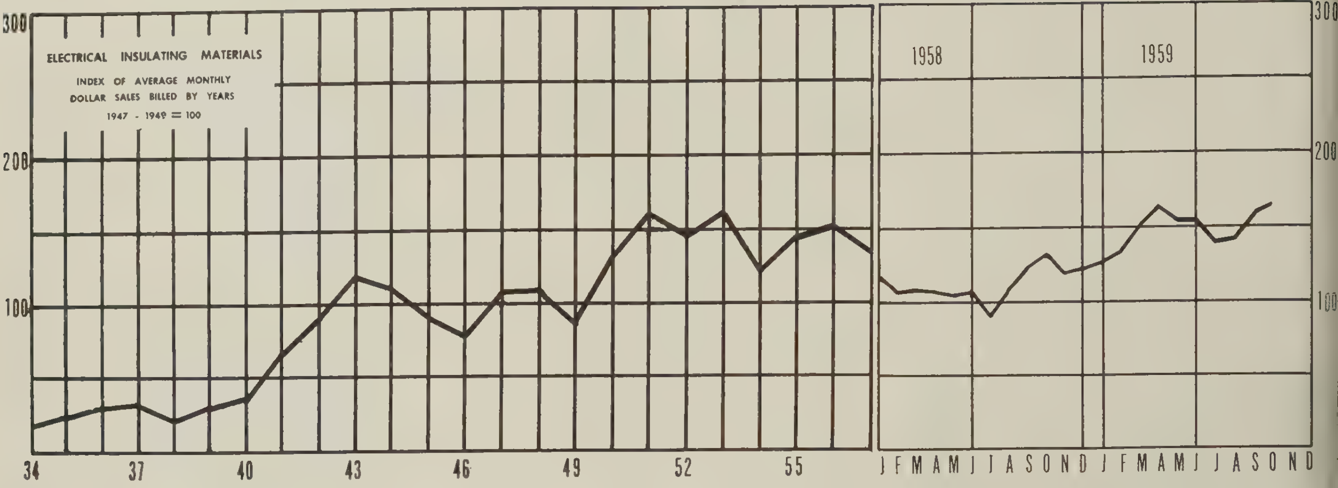
FOR HIGH TEMPERATURE USE

- ***Cured Tapes:*** Silicone rubber coated tapes in many variations of thickness, silicone compound and base fabric.
- ***Semi-Cured Tapes:*** A semi-cured silicone rubber coating on glass or other fabrics. Tape has no interliner and heat is required to bond multiple layers of tape. Tapes can be supplied coated on one side or two sides.
- ***Self-adhering Tapes:*** A self-adhering silicone rubber coating on glass or other fabrics. Tape has an interleaving layer and requires no heat for bonding adjacent layers.
- ***Temp-R-Tapes:*** Pressure sensitive: thermal curing tapes with backings of Teflon, glass fabric and silicone coated glass fabric — all with silicone adhesive. From stock.

For additional data, we invite your inquiry.

ELECTRICAL AND INDUSTRIAL SPECIALTY TAPES
CHR CONNECTICUT HARD RUBBER CO.
Main office: New Haven 9, Connecticut
Print Ins. 44 on Reader Service Card

NEMA Electrical Insulation Index



	Oct. '59	Sept. '59	Oct. '58
Index series	164	160	135
Oct. '59 point change from other mos.		+4	+29
Oct. '59 % change from other months		+3	+21

Index is based on 1947-1949 average month, inclusive= 100

Published through the courtesy of the National Electrical Manufacturers Association

Materials Used in Electrical Insulation Index

Industrial Laminated Products

Manufactured Electrical Mica

Varnished Fabric and Paper

Vulcanized Fibre

Varnished Tubing and Saturated Sleeving (From May 1952)

SILK . . . NYLON . . . VISCOSE . . . ACETATE FORTISAN . . . ORLON . . . DACRON and other

Yarns

for

- Serving
- Braiding
- Marker or Identification Threads
- Lacing & Tieing Cords
- Served Coverings and Binders

regular and custom constructed, dyed and packaged to "individual" specifications by

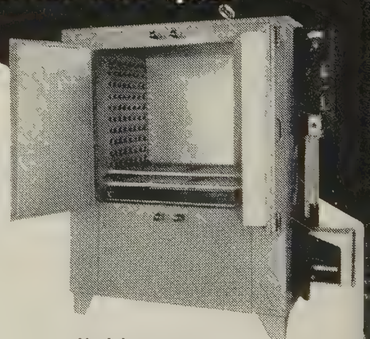
Belding Corticelli
Industrial Yarn Division,
1407 Broadway, New York 18, N. Y. • CHickering 4-6040

Print Ins. 45 on Reader Service Card

Precise engineering and construction result in

UNIFORM HEAT

throughout the work space



- High velocity recirculating blowers
- Greater heat input
- Adjustable louvres for balanced airflow
- Superior heat seals

All combine to provide *excellent temperature uniformity* in these rugged cabinet ovens.

30 Standard Models

- Work space from 4.6 to 72.3 cubic feet
- Temperature ranges from 100 to 1250° F.
- Electronic combustion devices insure safety for gas fired models
- Indicating control instrument
- Factory tested

Model HB Electric or Gas Cabinet Oven

Other ovens from $121.50 up, including a complete line of laboratory, bench, cabinet, walk-in, and custom-built units.

Write for literature to help you select the right oven for your application

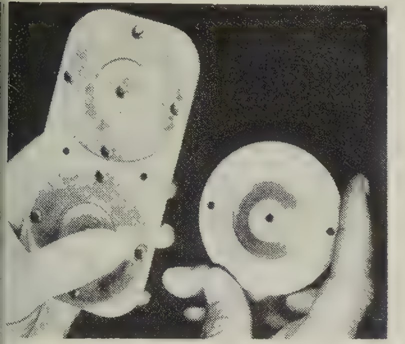
Specialists in Heat Process Equipment

GRIEVE-HENDRY CO.
1334 N. Elston Ave., Chicago 22, Illinois

Print Ins. 46 on Reader Service Card

w Design Reduces rminal Plate Cost

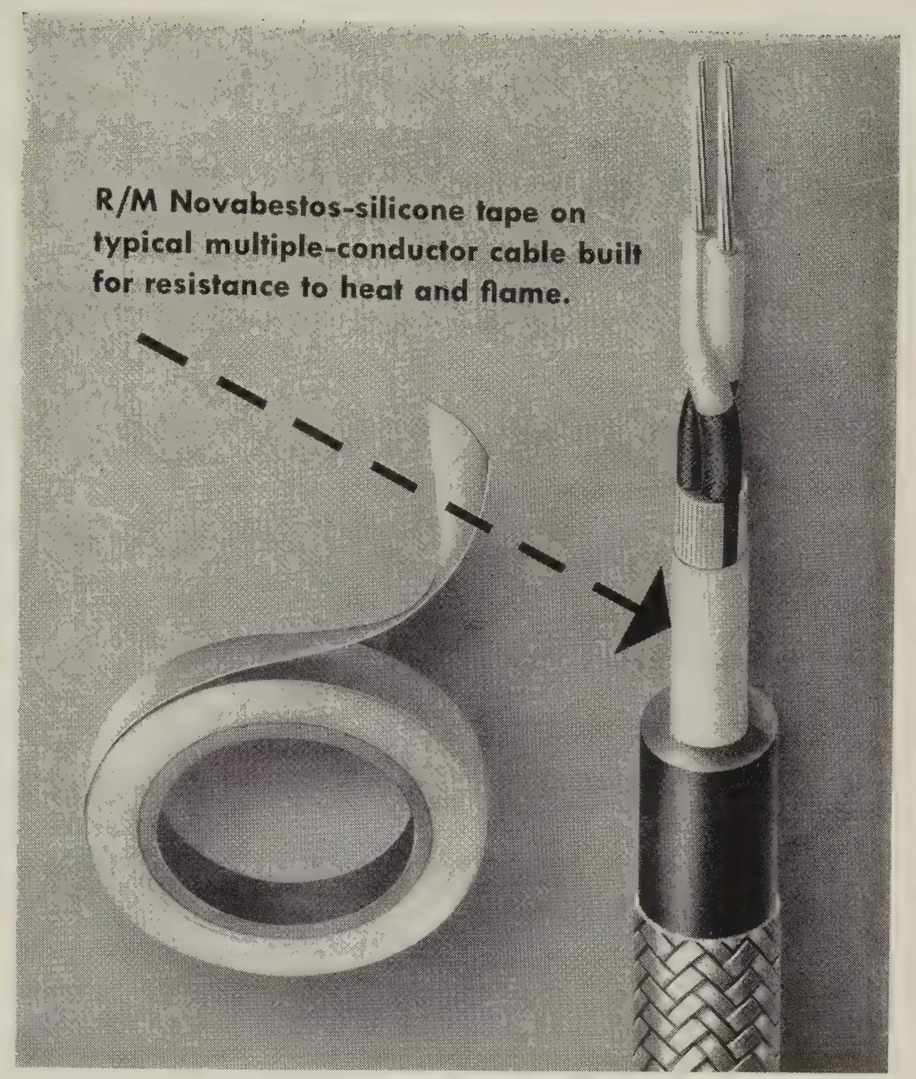
new design in beacon lamp ter- al plates (right in photo), utiliz- one piece of copper-clad "Pheno- ' laminate, is said to save five s in labor costs on each lamp. It eliminates the riveting operation uired by the former terminal plates t in photo) which were made of nt pieces, two zinc discs fastened n five rivets to a piece of laminated tic. The copper-clad laminate is punched to the required size and pe. A circular gap in the copper , between the inner and outer tact surfaces, is then cut away by inexpensive fly-cutting process, hout etching as is commonly done h printed circuit material. The minal plates are made by U-C Lite nufacturing Co., Chicago. The inate is supplied by National Vul- ized Fibre Co., Wilmington, Del.



ant Radar for pace Research

ornell University's new Radio- sics and Space Research Center, first such large university-spon- ed center, will soon begin construc- of the world's largest and most verful radar in Puerto Rico. In lition to other space research, it is ed that the radar will allow study he planet Jupiter, about 400-mil- miles away when closest to the th.

he radar will have a 1,000-foot e dish and a tripod 600 feet high porting the feed antenna. Signals be sent at a power peak of 2.5- ion watts and a frequency near megacycles.


R/M Novabestos-silicone tape on typical multiple-conductor cable built for resistance to heat and flame.

FLAME-RESISTANT INSULATION FOR SHIPBOARD CABLE

R/M silicone-coated Novabestos® Tapes

R/M Style 7527 Novabestos tape is a combination of three heat- and flame-resistant materials — asbestos paper, glass cloth, and silicone rubber. Its use is indicated for primary and secondary insulation in shipboard cable and where structural integrity is essential after severe exposure to heat or flame.

Dielectric strength of Style 7527 Novabestos averages 400 volts per mil thickness throughout the temperature range 30 to 125°C, and after 96-hour exposure to 96% relative humidity at 30°C.

R/M silicone-coated Novabestos tapes are made in 7-mil and 10-mil thicknesses, in widths from ½″ in ⅛″ increments. Core diameters are 1½, 3, 4 and 6 inches. Write for complete technical data and samples and ask also about Novabestos tapes impregnated with PVA or asphalt.

RM

ASBESTOS TEXTILE DIVISION
RAYBESTOS-MANHATTAN, INC.
Manheim, Pa.
SPECIALISTS IN ASBESTOS, RUBBER, ENGINEERED PLASTICS, SINTERED METAL

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HIGH VOLTAGE

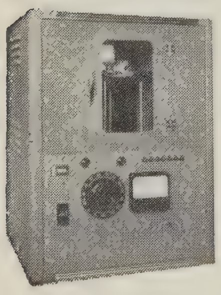
but no danger!

AC DIELECTRIC STRENGTH TESTER

- Conforms to ASTM D-149 and Federal Specification LP-406 Method 4031.
- Plug-in interchangeable test jigs for all ASTM tests.
- Automatic or manual increase of voltage.
- Completely interlocked for personnel safety.
- Self-contained test chamber.

MODEL	RANGE	PRICE
PA-5-152	15,000 V rms. 2KVA	1680.00
PA-5-155	15,000 V rms. 5KVA	2050.00
PA-5-252	25,000 V rms. 2KVA	1735.00
PA-5-255	25,000 V rms. 5KVA	2120.00
PA-5-502	50,000 V rms. 2KVA	1760.00
PA-5-505	50,000 V rms. 5KVA	2150.00
PA-50-1005	100,000 V rms. 5KVA	4500.00

ARC RESISTANCE TEST SET



- Conforms to ASTM D-495 and Federal Specification LP-406 Method 4011.2.
- Simplified operation, includes automatic stepping and timing.
- Improved electrode holder for test jig.
- Operable by unskilled personnel.

Price: Model ART-1 $1515.00

Write FOR COMPLETE ELECTRONIC TEST EQUIPMENT CATALOG...

Industrial Instruments, INC.
89 Commerce Road, Cedar Grove,
Essex County, N. J.

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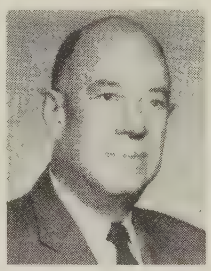
People in the News

Fred I. Johnson has joined Young Brothers Co., Cleveland industrial ovens manufacturer, as sales engineer covering Iowa, Wisconsin, northern Indiana, and parts of Illinois.

The Electric Autolite Co., Toledo, Ohio, has named *William F. Connolly* general sales manager for the Co.'s replacement sales div.; *J. M. Gerber,* operations manager for the General Products' Hazleton, Pa. plant; *D. M. Skirving,* western regional manager, Los Angeles; and *Virgil R. Steinmeyer,* eastern regional sales manager, New York City.



D. M. Skirving

V. R. Steinmeyer

Mitchell Specialty Div., Industrial Enterprises Inc., Philadelphia, has named *Alan J. Breslau* technical director; *Jack Dunnous,* director of systems development, Process Equipment Dept.; *Wilson B. Green,* district sales manager in Indiana, Kentucky, and Ohio; and *Emil G. Marcmann,* sales representative for the New Jersey and Pennsylvania area. The firm makes resin metering systems.

A. J. Breslau

J. Dunnous

W. G. Warne has been named production control manager by Precision Transformer Corp., Chicago.

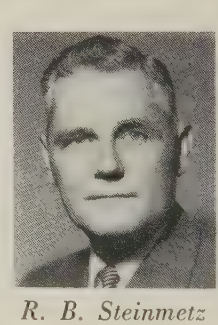
U. S. Transistor Corp., Syosset, L. I., N. Y., has named *Sydney Simon* vice president and director of engineering.

G. A. Eagleton and H. H. Gnuse, Jr. have been appointed assistant chief power engineers by Aluminum Co. of America, Pittsburgh, Pa. They will continue directing work in the hydraulic engineering and electrical engineering sections, respectively.

The Commercial Development Dept of Escambia Chemical Corp., New York City vinyl resin producer, has promoted *Erhart K. Drechsel* to manager, new product development.

Peter W. Duff has been appointe sales manager, Industrial Fabric Div., Hess, Goldsmith & Co., New York City fiber glass products producer.

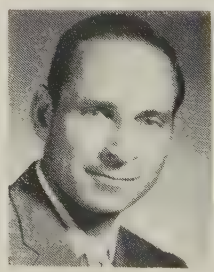
Richard B. Steinmetz has bee elected president of Anaconda Wir & Cable Co., New York City, succeeding *William E. Sprackling* who is re tiring. *William H. Benton,* genera manager of mills, has been elected t the board of directors.



R. B. Steinmetz

W. H. Benton

Semiconductor Products Div., Motorola Inc., Phoenix, has named *D Steward Flaschen* staff scientist.



S. Flaschen

D. E. Cordier

David E. Cordier has been a pointed technical director of Me Plastics Co., Los Angeles producer plastic molding compounds.

National Electric Welding Machines Co., Bay City, Mich., h named *Paul Thorne* chief electric and development engineer, and *Ha*

Major BREAKTHROUGH FOR INSULATION

LOW COST* IRRADIATION

New
DYNAMITRON** ACCELERATOR
FEATURES 10 TIMES MORE
PRODUCT THROUGH-PUT . . .
SAME CAPITAL INVESTMENT

TYPICAL LOW COST IRRADIATION APPLICATIONS

- **FOOD** — for preservation and spoilage reduction
- **DRUGS** — "cold sterilization" of antibiotics, surgical supplies and human tissue for transplant
- **RUBBER** — vulcanization at a fraction of the time and cost
- **PLASTICS** — cross-linking for increased temperature resistance, strength, insulating properties and chemical inertness
- **CHEMICALS** — initiating and increasing catalytic reactions
- **PETROLEUM** — "cracking" of crudes—higher yields
- **ELECTRONICS** — semi-conductive material research and improvement of wire coatings
- **RESEARCH** — basic research, higher yields, faster data accumulation

This entirely new concept in high voltage particle accelerators has broken the radiation "cost barrier." RDI's technological advance features **compactness, reliability, minimum maintenance** and **operating expenses,** and **low capital cost per kilowatt of radiation energy.**

RDI has constructed one of the largest radiation facilities in the country for the purpose of demonstrating practical industrial and military applications.

Dynamitron models are available from 0.5 Mev. to 3.0 Mev. in power ranges from 7½ Kw. to 30 Kw. For specific information on individual models and processing costs for your industry, write today to Application Engineering, Dept. K.

RADIATION DYNAMICS, INC.
Westbury Industrial Park
Westbury, Long Island

*$4.000 PER KILOWATT OUTPUT
**PATENTED

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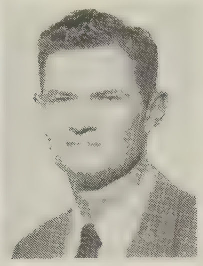
old Bach, chief welding engineer.

Harley J. Rittenhouse, Rochester, N. Y., will represent Associated Research Inc., Chicago manufacturer of electrical test equipment, in western New York state.

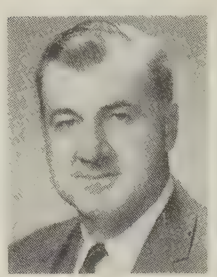
Winfield Shiras has been named vice president and general manager of Telex Inc., Minneapolis electronic systems manufacturer.

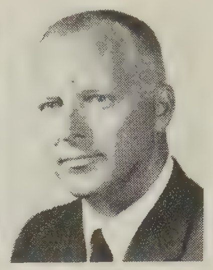
W. Shiras


J. B. Redwine

ETC Inc., Cleveland manufacturer of electric terminals and connectors, has appointed *John B. Redwine* assistant to the president.

Retiring *Charles C. Steck* has been succeeded by *Ellis C. Knobloch* as president of Spaulding Fibre Co., Tonawanda, N. Y. vulcanized fibre and laminated plastic producer. Steck will continue as a director for the company.


E. C. Knobloch


H. S. Thorpe

Harold S. Thorpe has been appointed general manager of Avnet Electronics Corp., Sunnyvale, Cal.

The Okonite Co., Passaic, N. J. wire and cable fabricating firm, has named *Edward C. Brass* manager of the firm's Cleveland office and *Walter G. Huber* Detroit Manager.

Chemo Products Inc., West Warwick, R. I. manufacturer of insulated tapes and yarns, has appointed *Albert C. Tieniber* sales engineer in New York City, New Jersey, Eastern Pennsylvania, and Philadelphia; *Herbert Whitaker* sales engineer for the New England area, and *Hugo Di Clemente* and *David Geddes* assistants to the sales manager.

Rodney H. Morrison has been appointed sales engineer by Davis-Standard Div., Franklin Research Corp., Mystic, Conn. extruder manufacturer.

R. H. Morrison

E. J. Wershey

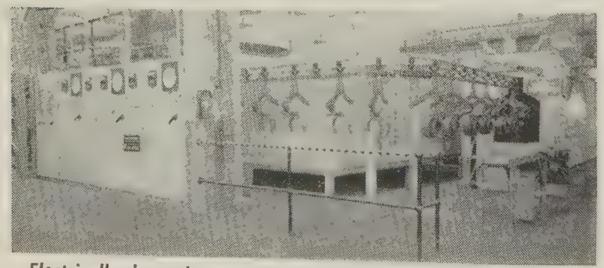
Electro-Capacitors Co., Oakland, Cal., has appointed *Edward J. Wershey* chief engineer and general manager.

Electronic Research Associates Inc., Cedar Grove, N. J., has appointed *Abraham B. Cohen* president, and *Edward V. Reiss* plant manager of ERA's new wholly owned subsidiary, Advanced Acoustics Corp., Nutley N. J., industrial sound equipment manufacturer.

STANDARD OR SPECIALLY DESIGNED

YOUNG BROTHERS OVENS

for dependable, economical BAKING and DRYING in the ELECTRICAL INDUSTRY



Electrically heated varnish baking, monorail conveyor oven.

The specialized knowledge gained in over 60 years of experience and in thousands of installations are available to meet your particular needs in Varnish Baking — Wire Enameling — Rubber and Plastic Curing, Paint and Enamel Baking — Glass Annealing — Service Shop Ovens. Young Brothers Batch or Conveyor Ovens will improve your product . . reduce your costs. Write for New Bulletin 157.

YOUNG BROTHERS COMPANY
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VARNISHES LACQUERS
ADHESIVES COMPOUNDS

CONTACT US FOR INFORMATION ON OUR NEW — LOW COST INSULATING—POTTING—FILLING COMPOUND

100% Non Volatile Low Viscosity
Heat Reactive — No Catalyst — Long Storage Life
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STANDARD & CUSTOM PRODUCTS
For Every Electrical Application
ENGINEERED TO MEET YOUR MOST EXACTING REQUIREMENTS

LET US SOLVE YOUR INSULATION PROBLEMS

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456 Broad Street Waverly, New York

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William Brand & Co. Inc., Willimantic, Conn. insulation and in- ulated wire firm has appointed *Frank aunders* to the newly created post assistant sales manager, Western iv.

Irving P. Magasiny has been ap- ointed director of engineering by haevitz Engineering, Pennsauken, . J. electronics specialty firm.

I. P. Magasiny

J. A. Royal

Taylor Fibre Co., Norristown, Pa., is made the following appointments: *ohn A. Royal,* manager of vulcanized ore sales; *James J. Kelly,* assistant the vice president—manufacturing; *oseph J. Shanda,* plant engineer; and *oyd J. Beesley,* assistant plant engi- er.

U. S. Industrial Chemicals Co. Div., ational Distillers and Chemical orp., New York City, has named *ohn A. Putnam* manager, Atlanta fice; *Joseph G. Longstreth* manager, . Louis office; *Roy A. Parker* man- ger, Kansas City office; and *Albert Brooks* manager, Baltimore office.

Earl E. Sargent has been appointed anager of the Muncy, Pa. plant of e Computer Products Operations of ylvania Electric Products Inc. Syl- nia's Electronic Systems Div., altham, Mass., has appointed *Cur- s A. Haines* vice president, facilities d manufacturing planning.

Narda Ultrasonics Corp., Westbury, . Y., has named *Walter H. Venghous* ce president and manager of manu- cturing.

Israel J. Melman has been ap- inted director of a new solid state boratory by Servo Corp. of Ameri- ., Hicksville, L. I., N. Y. electronics mponents manufacturer.

Fluorulon Laboratories, Caldwell, . J. insulation producer, has named *ax B. Olbeter* sales manager.

Philip D. Reed has retired from eneral Electric Co. after being as- ciated with the company for 33

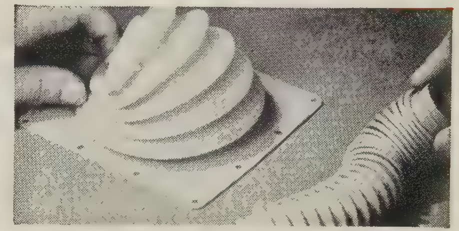
SEND FOR THE MOXNESS STORY... *Today*

MOXNESS *specialists in*

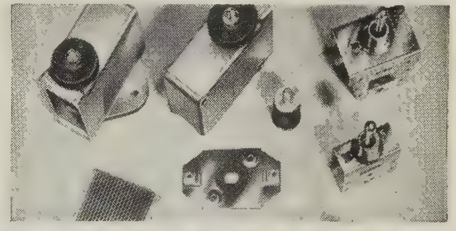
SILICONE and FLUOROCARBON

***Extreme Temperature Materials* ✻**

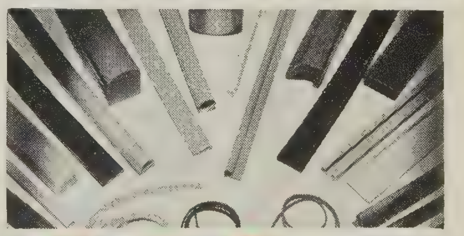
✻MOLDED
Complete, modern, mass-production facilities . . . in the hands of experienced operators who *know* Silicone and Fluorocarbon rubber fabrication . . . plus continuing quality-control production checks . . . all add up to the high standard of quality upon which Moxness stakes its reputation.



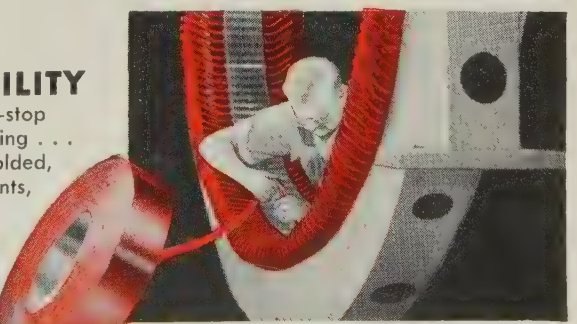
✻BONDED
These "samples" will show you why Moxness is fast becoming recognized as an authority in this specialized field of bonding rubber to many types of metals. The new Moxness plant provides ample facilities for rubber-to-metal bonding to meet exacting specifications and production requirements. Inserts may be furnished by the customer or produced in our plant.



✻EXTRUDED
Large, small, simple or complex . . . here are samples of the wide range of quality extrusions you can expect from Moxness. And, special equipment and an exclusive process developed by Moxness for the precision production of extruded parts is the reason why you will pay less for quality extrusions from Moxness.



**ONE SOURCE...
ONE RESPONSIBILITY**
Moxness offers complete one-stop service . . . Product Engineering . . . Tooling . . . Production. In molded, bonded or extruded components, or in the New TRIANGULAR MOX-TAPE with the Color-Guide Line that cuts taping time by 50-60%. Write for the Moxness Story today!



MOXNESS

MOXNESS PRODUCTS, INC.
1915 Indiana Street • Racine, Wisconsin
Subsidiary of NATIONAL RIVET and MFG. CO.

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years. Last year he retired as chairman of the board and continued with the company as chairman of the finance committee of the board of directors. In G-E's Insulating Materials Department, Schenectady, N. Y., *A. L. Baldock* has been appointed marketing manager. The Silicone Products Department, Waterford, N. Y., has appointed *Thomas S. Moroney* as sales representative for the Cleveland district, with headquarters in Detroit.

NRC Equipment Corp., Newton, Mass. vacuum equipment producer, has appointed *R. H. Binkerd* general sales manager.

Royal Industries Inc., Beverly Hills, Cal. electronics manufacturer, has appointed *J. R. Johnson*, executive vice president. *Harry Houdyshell* has been named chief engineer, and *Dean Oleson* assembly superintendent of the company's Pacific Electronic Controls Div.

Wesley E. Gatewood has been named director of field sales for the Barrett Div., Allied Chemical Corp., New York City.

Randolph H. Barnard has resigned as president of Johns-Manville Fiber Glass Inc., a subsidiary of Johns-Manville Corp., Toledo. *Francis H. May Jr.*, vice president, assumes full responsibility for administration.

Associated Research Inc., Chicago, has appointed *Allen C. Craft Jr.*, Atlanta, Ga., to represent the firm's line of test equipment in Georgia, Alabama, and North and South Carolina.

John Fiske has been appointed director of magnet wire sales by Essex Wire Corp., Fort Wayne, Ind. He had been Cleveland office manager for 15 years.

H. B. Fuller Co., St. Paul, Minn. epoxy producer, has named *Ward Oliver* assistant manager of the Chicago office and *Norbert E. Hochreiter* sales manager of the Linden, N. J. office. *Grant V. Disbrow* has been named sales representative in Michigan, Indiana, West Virginia, and Kentucky for the company's Resiweld epoxy resin division, and *William D. Dunn* sales representative in the Louisville, Ky. area.

Maxwell H. Harts has been appointed chief engineer of Alpha Wire Corp., New York City.

Monogram Precision Industries Inc., Culver City, Cal. electronic components manufacturer, has appointed *Roderic L. Fischer* general manager of Cascade Research Div., and *J. A. Rathbone* chief project engineer, Advanced Structures Div.

Derio Dalasta has been named head of the switchgear department, static relay section of Allis-Chalmers Mfg. Co., Milwaukee.

Whittaker Controls Div., Telecomputing Corp., Los Angeles aircraft component producer, has appointed *John R. Morton* production engineering manager.

J. R. Morton

J. E. Schmitz

John E. Schmitz has been named general manager and chief engineer of the Chemical Div., Electronic Production & Development Inc., Hawthorne, Cal.

Mort V. Bunnell has been promoted to sales manager of Avnet Corporation, Beverly Hills, Cal. electrical connector manufacturer.

Anaconda Wire and Cable Co., New York City, has announced the following elections or appointments: *David E. Allen*, vice president, sales, is now executive vice president. *William H. Benton Jr.*, formerly general manager of mills, has become vice president, manufacturing. *John L. Tindale*, formerly commercial vice president, has been named vice president, marketing and sales. *Henry V. Van Valkenburg*, formerly general sales manager, is now vice president and general sales manager. *William C. Kratz*, manager of the mill at Muskegon, Mich., has been appointed manager, magnet wire manufacturing. He is succeeded by *Roy M. Hukle*, former mill superintendent. Anaconda also has announced the retirement of *Samuel J. Rosch*, consulting cable engineer at Hastings-on-Hudson, N.Y., after 40 years of service with the company. *Charles B*

4027

NOW A TWO-PART EPOXY MIXTURE FOR IMPREGNATING AND MOLDING ALL ELECTRICAL WINDINGS

NOW—an epoxy mixture, formerly in three parts, now comes complete, ready to mix and use in TWO PARTS. Nothing else to buy!

This remarkable mixture, designated as Acme Star Compound 4027, is immediately self-extinguishing on molded units, even after repeated exposure to flame! Cures hard and tough. Has excellent mechanical and thermal shock resistance. Viscosity low enough for thorough impregnation at process temperatures. Very good adhesion to metals and other materials used in coil construction. For Data Sheets write us attention G. F. Garrity, Divisional Sales Manager.

THE ACME WIRE COMPANY
NEW HAVEN, CONN.
MAGNET WIRE • COILS • VARNISHED INSULATIONS
INSULATING VARNISHES AND COMPOUNDS

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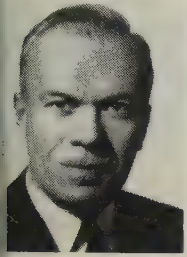
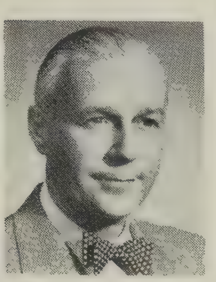
wnsend, manager of the Sycamore, l. mill, has also retired after more in 30 years of service.

D. E. Allen

W. H. Benton

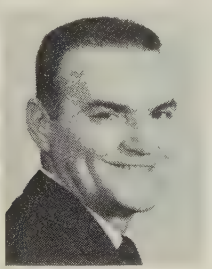

J. L. Tindale


Van Valkenburg

William M. Temple has been named anager of government sales for the ethane Div., The Dayton Rubber ., Washington, D.C. He formerly as with L-O-F Glass Fibers Co.

William H. Bentley Jr., has been omoted to executive vice president, ntley-Harris Manufacturing Co., onshohocken, Pa. He joined the bing and sleeving manufacturing m in 1950 and had formerly held e positions of sales manager and sistant to the president.

W. H. Bentley


Fred Scott

The former manager of the Kear- tt Manufacturing Co. Newark plant, *ed Scott*, has been named general ant manager, Astron Corp., East ewark, N.J., capacitor producer.

Gerald E. Kanen has been ap- inted test engineer at Servonic In- ruments Inc., Costa Mesa, Cal., tentiometer and transducer manu- cturer.

J. Alfred Earl has been named chief ramics engineer, Technical Indus- ies Corp., Pasadena, Cal., producer

VARFLEX

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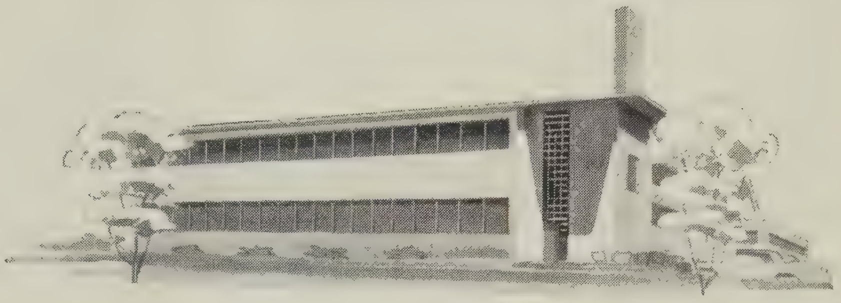
SLEEVING and TUBING

used by leading American manufacturers


Varflex Corp. factory in Rome, N.Y.

Pick up any combination of characteristics, and there is a Varflex sleeving or tubing to meet them. In the toughest applications of all—in jet plane components which *must* operate efficiently at temperatures ranging from —85° to 500° F.—Varflex has proved its reliability again and again.

Any or all of the following characteristics are available in the degree that fits your application: high dielectric retention . . . high thermal stability . . . high tensile, mechanical or impact strength . . . non-interference with magnetic field . . . excellent resistance to oil, grease, alkali, acid, heat, pressure, vibration.

Choose from the World's MOST COMPLETE LINE

Varglas Silicone Rubber Tubing. Class H-A-1. The ultimate in flexibility, yet dielectric protection to 8000 volts. Class H-B-1 (4000 volts) available, also. Continuous exposure from minus 70°F. to 400°F. does not affect coating or braid.

Varglas Silicone Rubber Sleeving. Made in Class H-C-1 (2500 volts) and Class H-C-2 (1500 volts).

Varglas Silicone Resin Tubing. Class H-A-1 is recommended for applications requiring extremes of heat endurance and high dielectric strength (7000 volts). Class H-B-1 is identical except for dielectric guarantee (4000 volts). Good abrasion resistance.

Varglas Silicone Resin Sleeving. Made in Classes H-C-1 (2500 volts), H-C-2 (1500 volts) and H-C-3.

Silflex Sleeving. A light coating of Silicone resin on fiberglas braid. Extremely flexible within a temperature range from minus 85°F. to 500°F.

Varglas Silicone Lead Wire. Made from solid or stranded wire covered with one or more walls of Fiberglas braid and impregnated with Silicone resin.

Varglas Silicone Tying Cords. Continuous filament Fiberglas cords impregnated with Silicone resin. 1/64" to 1/8" diameter. Specify dry cure or tacky cure.

Varfil Tubing and Sleeving. Fiberglas braids impregnated with polyester resin. Four grades available in coils as well as 36" lengths in most sizes. In a class by itself because of its toughness, flexibility, high temperature resistance and ability to withstand bending and twisting without dielectric loss. Compatible with varnish.

Varflo Tubing and Sleeving. Class B insulation. For those who need flexibility, solvent, oil and moisture resistance, and yet do not require Class H insulation. Will pass the NEMA heat endurance test of 15 minutes at 425°F. Also passes 300 hours at 300°F. Varflo has good shelf life and will not lose dielectric strength when subjected to severe twisting.

Varglas Varnished Tubing. Flexible continuous coatings of flame resistant varnish built up over Fiberglas braid in eight or more carefully controlled operations.

Varglas Varnished Sleeving. NEMA Classes B-C-1, B-C-2, and B-C-3 are similar except for dielectric strength.

Varglas Non-Fray Sleeving—Type H. The normalizing treatment given the Fiberglas braid removes the organic impurities and tends to hold the individual filaments together. May be subjected to temperatures as high as 1200°F. Recommended for applications where dielectric requirements are not of prime importance. Resists fungus and is non-corrosive.

Varglas Non-Fray Sleeving—Type HO. Has a very light treatment of resin after the braid has been normalized—just enough to hold the sleeving round for accurate cutting. Will distend to cover soldered joints or terminals. Available in eight colors, sleeving unaffected up to 1200°F.

Varglas Litewall Sleeving. Wall thicknesses of .008" and .006" available untreated or treated.

Syntholvar Extruded Tubing. Several formulations of vinyl polymers. All have high dielectric and tensile strength. Will not support combustion nor absorb moisture. Smooth surface, thin wall and flexibility all make for ease in assembling operations. For installations where temperatures of 105°C. must be withstood. Also will function at temperatures down to —65°C. Specify fungus resistant tubing where needed.

Varflex Cotton Tubing. Furnished with lacquer or varnish as the impregnant. Braided from long staple cotton yarns. Four standard NEMA grades.

Varflex Cotton Sleeving. Available in three NEMA grades, Classes A-C-1, A-C-2, and A-C-3.

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Varflex
CORPORATION
Makers of
Electrical Insulating
Tubing and Sleeving

of transducers, wire, and connectors.

Avnet Corp., Sunnyvale, Cal., has appointed *Burton H. Berman* as executive assistant. The firm makes electrical connectors.

Joseph E. Trankla has been named assistant general manager, Anadite Inc., South Gate, Cal., anodizing firm.

Servo Corp. of America, Hicksville, N.Y., electronics firm, has appointed *Joseph E. Bambara* director of industrial products engineering. He had been vice president of CBS' electronic systems laboratory.

Herman L. Weiss, formerly general manager, Large Lamp Dept., has been named general manager of General Electric Co.'s Lamp Div., Cleveland. G-E's Silicone Products Dept. has named *George E. Shepherd* as manager of the newly established New England sales district with headquarters in Boston. He has been with the department since 1950.

Samuel L. Apter, co-founder, first president, and a director of Sealectro Corp., Mamaroneck, N.Y., has resigned from the company and disposed of all his stock interest.

Arthur J. Briggs, previously vice president in charge of sales, has been promoted to vice president in charge of marketing for Continental-Diamond Fibre Corp., Newark, Del., electrical insulation manufacturer. *Harold Moyer*, formerly Philadelphia district office manager for CDF has been promoted to field sales manager.

A. J. Briggs

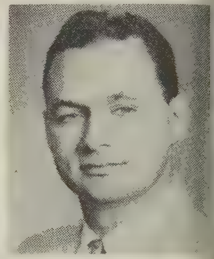
Harold Moyer

Nicholas R. Sheehan, previously a product sales manager, has been promoted to manager of the industrial sales division for the Dobeckmun Co., Cleveland, producer of electrical insulation tapes and laminates.

After nine years with the National Bureau of Standards, Washington, D.C., *Raymond R. Bouche* has joined Endevco Corp., Pasadena, Cal., instrumentation manufacturer, as manager, Standards and Analysis Dept.

George P. Kern, former vice president, Gates Engineering Co., has joined the planning division of the special products marketing dept. of the United States Gasket Co., Plastics Div. of Garlock Packing Co., Camden, N.J.

G. P. Kern


J. J. Farley

Synthane Corp., Oaks, Pa., laminated plastics manufacturer, ha named *James J. Farley* as sales representative in the Baltimore office.

William C. Leone, previously with Hughes Aircraft Co., has joined Rheem Califone Corp., Los Angeles electronics manufacturer, as vice president and general manager.

TONOX

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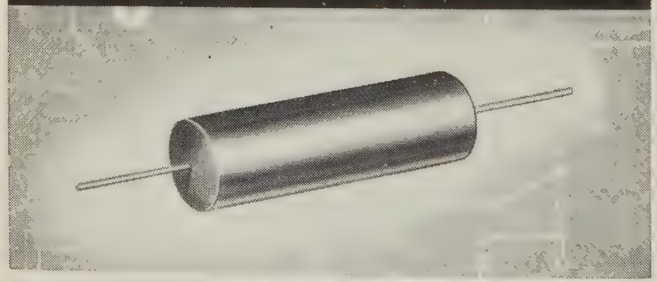
for encapsulating electrical components



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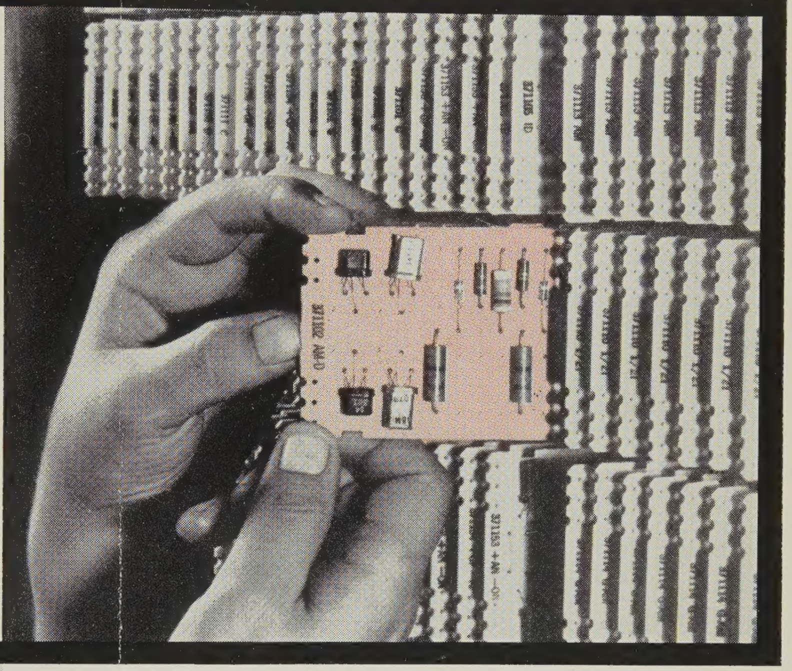

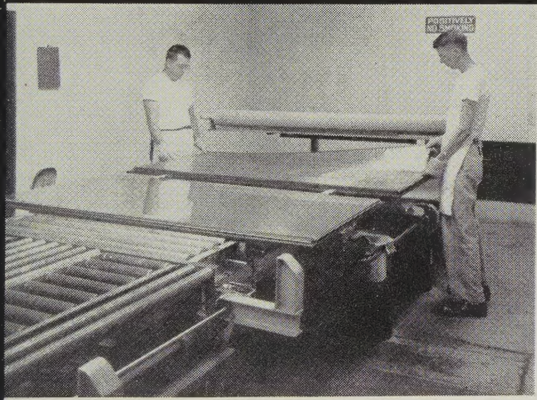

G-E Textolite Copper-Clad Laminates are designed to meet or surpass stringent computer and military requirements. To do this, and assure superior performance with maximum circuit reliability and minimum rejects, *engineered cleanliness* is maintained in the entire production process.

All G-E Textolite Copper-Clad Laminates are produced in the sterile atmosphere of the room pictured at left. Washed, filtered, conditioned air eliminates dust and dirt. Special cleaning techniques for copper and press pans assure a smooth continuous surface. Pits, dents, pinholes and scratches are virtually eliminated. And the G-E engineered cleaning process just before inspection completes the job.

Try these outstanding General Electric Textolite grades:

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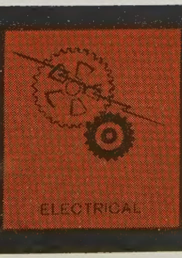
#11571—NEMA XXXPC—Highest IR phenolic paper
#11559—NEMA G-11—Self extinguishing epoxy glass
#11558—NEMA G-10—Best machining epoxy glass

Write for samples to: Laminated Products Department, Section 60-1
General Electric Company, Coshocton, Ohio.



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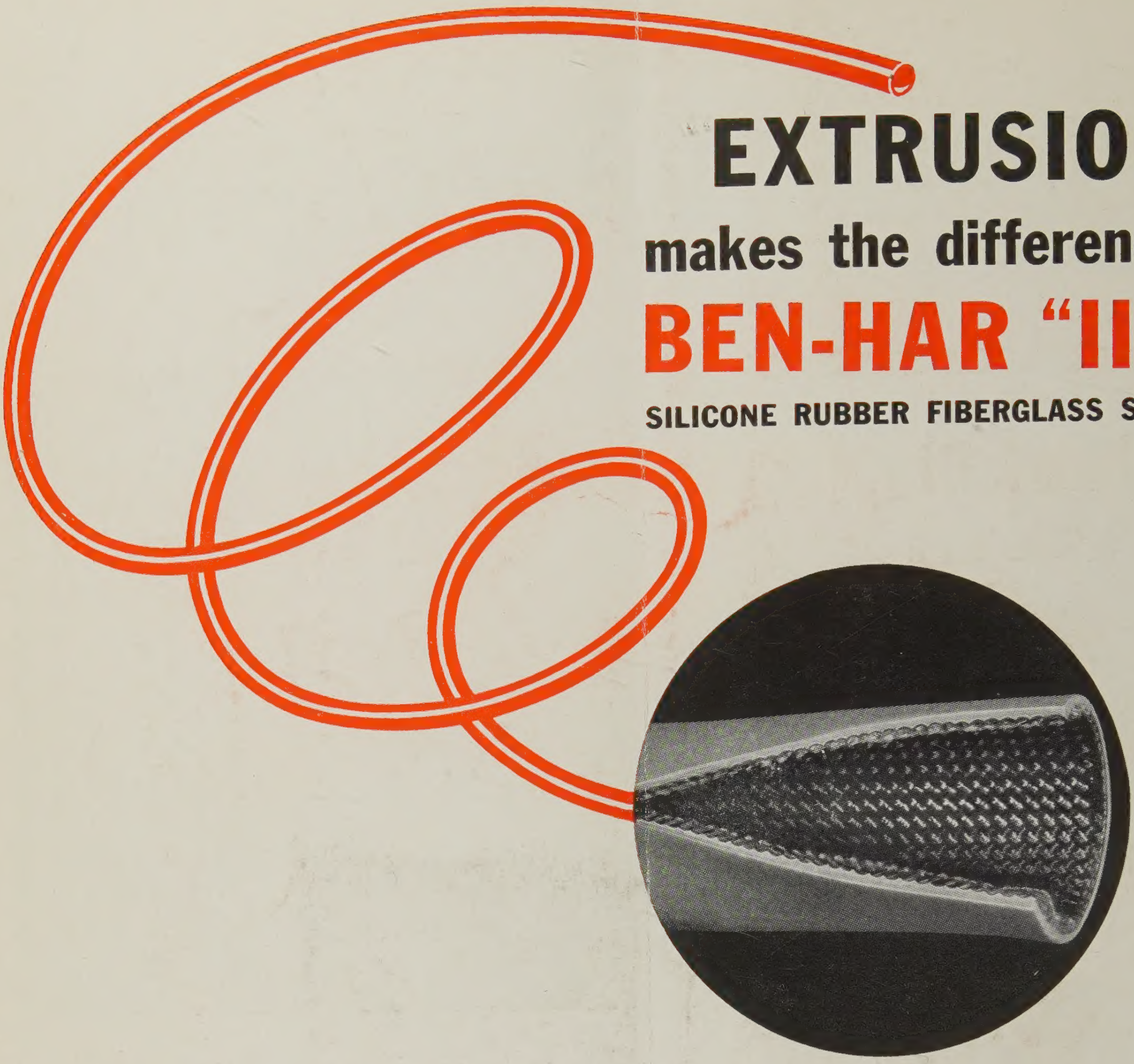

The super-tough **durasyl** silicone rubber coating of Ben-Har "1151" is so tough and so effectively bonded to the supporting braid that breakdowns caused by pushback, abrasion or rough handling are eliminated. Applied by a new extrusion process, **durasyl** is so flexible that expansion up to a 400% increase of a.w.g. size is possible, minimizing tolerance problems.

Extrusion technique permits continuous electronic inspection, assuring absolute uniformity and unique outside diameter control, holding it to a maximum of ± .005 inches.

These are some of the superior advantages Ben-Har "1151" offers over conventionally dip-coated class H sleevings . . . send now for free testing samples and data sheet.

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